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VISUALIZATION OF SUPRASELLAR TUMORS BY ENCEPHALOGRAPHY*

A REPORT OF NINE CASES

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BECAUSE of their strategic location and tendency to calcification, tumors of the suprasellar region generally are easily localized by an evaluation of their clinical and roentgenographic manifestations. Other adjuncts to correct localization are often useful for these as well as for other intracranial tumors, especially when the clinical syndromes are atypical and the roentgenograms are not helpful.

Heuer and Vail[9] consider optic atrophy alone, without any other clinical manifestations of disease, a positive indication for chiasmal exploration. Globus,[6] in reporting 7 tumors of the chiasmal region, emphasized the importance of utilizing all possible diagnostic means to differentiate the tumors found in this region and concluded that they could not all be predicated clinically, and that exploratory operation alone would allow of final diagnosis in many cases. Encephalography is frequently of value in confirming or excluding the diagnosis of suprasellar tumor, thereby saving patients the inconvenience and risk of needless exploratory operations. It is not suggested that encephalography be employed routinely where suprasellar tumors are suspected; the great majority of cases do not require it. But in cases which do not lend themselves well to localization, this procedure may be found helpful.

Many neurological surgeons have been reluctant to employ encephalography when the patients have increased intracranial pressure or brain tumor. In a report of 24 encephalograms on 19 patients with increased intracranial pressure, Gardner[4] demonstrated the utility of the method in these cases and outlined certain precautions that reduce to a minimum the dangers of the procedure under these circumstances. In a later paper,[5] 50 consecutive cases were reported in which encephalography was performed in the presence of surgical lesions of the brain. The necessity for performing exploratory operations for unlocalizable tumors was thus greatly reduced.

Cerebral pneumoroentgenography has been employed in the diagnosis of other lesions in the neighborhood of the sella. Dandy[1] emphasized the importance of ventriculography in the diagnosis of tumors of the third ventricle, and differentiated the findings in these cases from those of tumors of the interpeduncular

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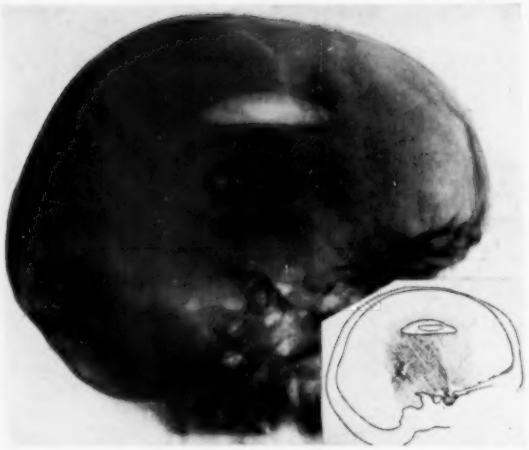

FIG. 1. Case I. Suprasellar craniopharyngioma. The lateral ventricles are dilated and incompletely drained; the third ventricle is retrodisplaced and compressed to a flat band. The cisterna chiasmatis is obliterated, and the cerebral sulci are not visualized.

region. He also[2] discussed the ventriculographic phenomena of hypophyseal duct tumors. Zimmerman and German[11] described the ventriculographic findings in 2 cases of colloid tumor of the third ventricle. Schwartz and Dyke[10] noted that the infundibulum and the superior aspect of the hypophysis could be visualized by ventriculography in the presence of severe hydrocephalus. This observation required the presence of a widely dilated third ventricle to act as a "balloon" of air overlying the parts mentioned. In 1928, Heidrich[7] called attention to the visualization of the upper limits of a pituitary tumor by encephalography and said that suprasellar extensions of these tumors should be visible by this procedure. The following year[8] he was able to make such an observation and to check his finding by post-mortem examination. He found in the case of a pituitary tumor which had grown into the suprasellar region, that the top of the lesion was beautifully outlined by the basal cisterns that had been "elevated" from the floor of the skull. He concluded that a large pituitary tumor cannot close the basal cisterns, but that enough space would always exist to permit visualization of the lesion. He proposed the procedure to be used to determine whether a transnasal or an intracranial attack should be made upon a pituitary tumor. Visualization of the basal cisterns and their contents in normal subjects by encephalography was discussed in detail by Dyke and Davidoff.[3]

Encephalography has been employed in 10 instances of suspected sellar tumor in this Clinic, and the data obtained seem worthy of record. Tumors of the pituitary gland extending into the suprasellar region have been excluded from the series. Tumors of the hypothalamus and third ventricle are not included in the group as their pneumoroentgenographic characteristics have been previously demonstrated. As may be seen by consulting the following case summaries, the diagnosis of suprasellar tumor was partly or completely justified in each instance on the clinical findings alone. In the tenth case, although the clinical diagnosis appeared fairly certain, operation disclosed no tumor.

REPORT OF CASES

CASE I. A youth, aged eighteen, with Froehlich's syndrome, had diffuse haziness of the optic discs with concentric contraction of the

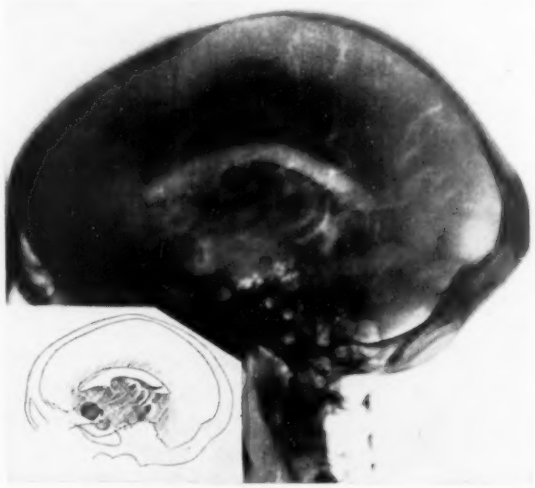

FIG. 2. Case II. Suprasellar craniopharyngioma. The lateral and third ventricles are normal. The cisterna chiasmatis is obliterated, a 2 cm. filling defect is outlined above and anterior to the sella. The visible cerebral sulci are markedly diminished, especially over the frontal lobe.

visual fields. Roentgenograms of the skull showed an intrasellar calcification. The spinal fluid pressure was 510 mm. of water. The clinical diagnosis was suprasellar tumor.

The encephalogram showed widely dilated lateral ventricles which were drained incompletely, marked retrodisplacement and compression of the third ventricle, and obliteration of the cisterna chiasmatis. The cerebral subarachnoid spaces were not filled.

Operation disclosed a large craniopharyngioma. The calcification seen on the roentgenogram was within the cyst wall.

Case II. A white woman, aged thirty-three, whose chief complaint was failing vision, had primary optic atrophy, right blindness and loss of the left temporal visual field. The clinical diagnosis was suprasellar tumor.

The encephalogram showed no changes in the lateral or third ventricles, but the cisterna chiasmatis was obliterated and a rounded mass, 2 cm. in diameter, was outlined above and in front of the sella. The subarachnoid spaces were greatly diminished, especially in the right frontal area.

Operation disclosed a cystic craniopharyngioma.

Case III. A white man, aged forty-two, complained of progressive visual failure and headache. Examination disclosed a low grade papilledema and a suggestion of a right homonymous defect in the visual fields. A subtemporal decompression had been performed previously. The clinical diagnosis was suprasellar tumor.

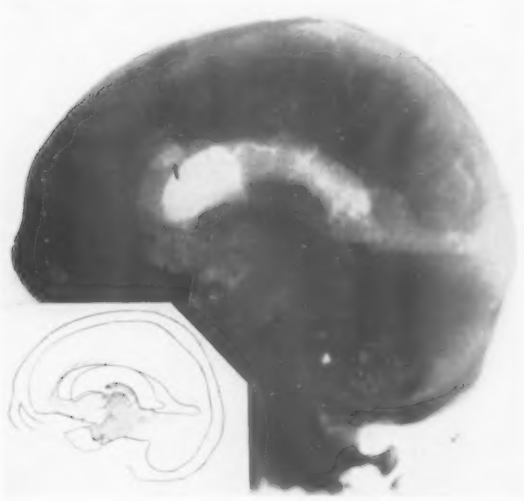

Fig. 3. Case III. Suprasellar craniopharyngioma. The lateral ventricles are dilated. The third ventricle is displaced upward and compressed to a narrow band. The cisterna chiasmatis is obliterated.

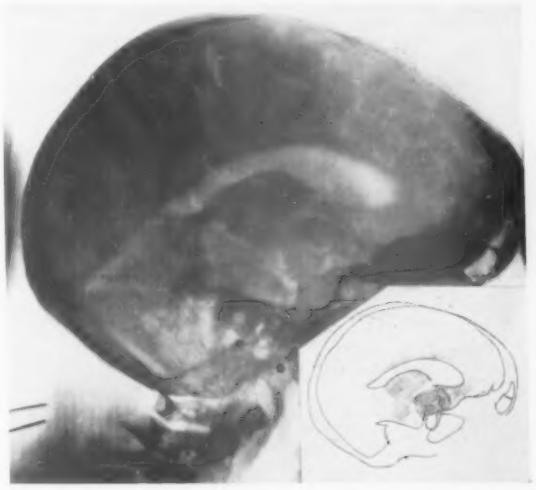

Fig. 4. Case IV. Suprasellar craniopharyngioma. The lateral ventricles are normal. The third ventricle is displaced upward by a mass outlined above the sella. The cisterna chiasmatis is obliterated, the cisterna pontis is invaded by the posterior border of the filling defect.

Encephalography revealed dilatation of the lateral ventricles with elevation of the anterior horns. The third ventricle was dilated laterally, displaced upward and compressed to a narrow band. There was a filling defect in the cisterna chiasmatis and the subarachnoid spaces seemed normal.

Operation revealed a large craniopharyngioma.

Case IV. A girl, aged twenty-two, who had had amenorrhea for four years and had suffered from frontal headache for three years, had noted failing vision for one year. Examination revealed primary optic atrophy and bitemporal hemianopsia. In the roentgenogram the skull and sella appeared normal. The diagnosis was suprasellar tumor.

According to the encephalogram, there was no change in the lateral ventricles or the subarachnoid spaces. A filling defect, 2.5 cm. in diameter, overlying the sella, was outlined by the air in the third ventricle and cisterna pontis.

At operation a cystic craniopharyngioma was found.

Case V. A woman, aged fifty-six, had had gradually failing vision without signs of in-

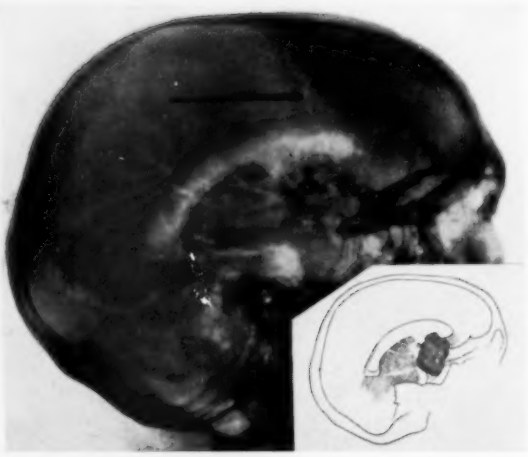

FIG. 5. Case V. Suprasellar meningioma. Convex filling defect in floor of anterior horns. The third ventricle has an antero-inferior filling defect. The cisterna chiasmatis is obliterated. Visible cerebral sulci are much diminished.

creased intracranial pressure. Examination revealed primary optic atrophy, blindness in the left eye and loss of the right temporal field.

The clinical diagnosis was suprasellar tumor.

The encephalogram disclosed a convex filling defect in the floors of the anterior horns of the lateral ventricles, a convex filling defect in the anterior one-third of the third ventricle, and obliteration of the cisterna chiasmatis with an indistinct outline of an ovoid filling defect 2×3 cm. over the eroded sella. The subarachnoid spaces were greatly decreased.

A suprasellar meningioma was disclosed at operation.

CASE VI. A woman, aged thirty-nine, with progressive visual failure, had primary optic atrophy, and vision so reduced that visual field examination was impossible. Suprasellar tumor was the clinical diagnosis.

The floors of the anterior horns of both lateral ventricles were elevated, the cisterna chiasmatis was obliterated and an ovoid filling defect was outlined just anterior to the sella. The subarachnoid spaces were diminished, especially in the frontal area. The lesion was found to be a large suprasellar meningioma.

CASE VII. A youth, aged eighteen, suffered diminution of vision in the right temporal field and examination disclosed diffuse haziness of both optic discs, right homonymous hemianopsia and a spinal fluid pressure of 350 mm. of water.

The encephalogram showed that the cisterna chiasmatis was obliterated and there was a rounded filling defect 2.5 cm. in diameter above the sella. The floor of the third ventricle was slightly elevated.

Operation disclosed a rounded tumor, a fibrillary astrocytoma, 2.5 cm. in diameter, which included the chiasm, optic nerves and invaded the hypothalamus.

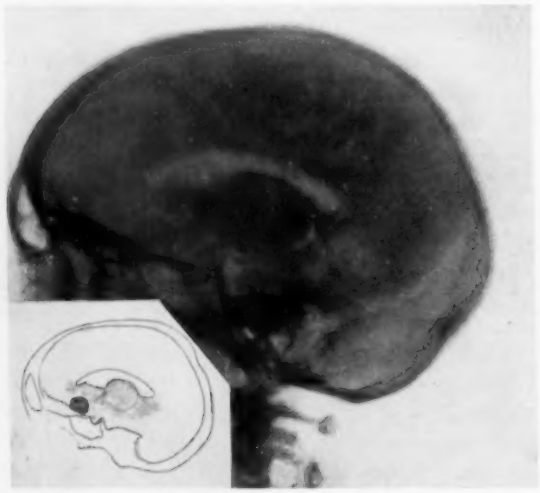

FIG. 6. Case VI. Suprasellar meningioma. Slight elevation of floors of both anterior horns. The third ventricle is normal. The cisterna chiasmatis is obliterated. A 2.5 cm. filling defect is outlined just anterior to the sella.

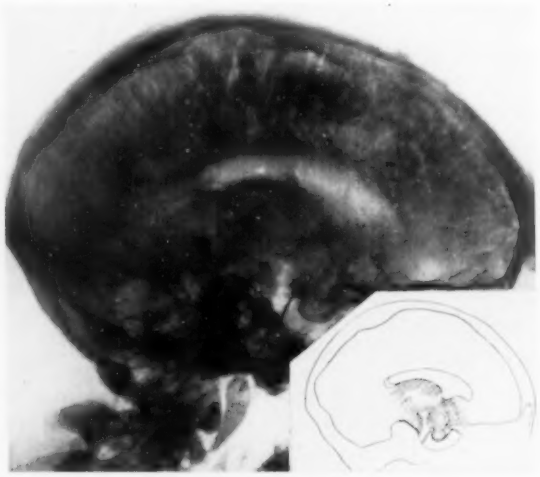

FIG. 7. Case VII. Glioma of the optic chiasm. The lateral ventricles are normal. The floor of the third ventricle is slightly elevated. The cisterna chiasmatis is obliterated. A rounded, 2.5 cm. filling defect is outlined above the sella. Cerebral sulci are well visualized.

Case viii. A woman, aged forty-three, had suffered for two weeks from marked progressive failure of vision, and vertex and frontal headaches. Examination showed pallor of the optic discs and a bitemporal hemianopsia with loss of macular vision.

The clinical diagnosis was suprasellar cyst with hemorrhage.

The subarachnoid spaces were uniformly diminished and the infundibulo-chiasmal shadow appeared thicker than normal. Otherwise there were no significant changes in the encephalogram.

Exploration showed that the optic nerves and the chiasm were greatly enlarged, and the nerves were constricted at the optic foramina, giving the gross appearance of a glioma of the optic chiasm. Biopsy was not made.

Case ix. A youth, aged seventeen, had suffered a severe cranial injury seven years before, and since then bitemporal headaches had been increasing in severity and frequency. The patient's appearance was suggestive of mild cretinism. The optic discs were diffusely hazy and the right inferior temporal visual field was slightly constricted. The clinical diagnosis was suprasellar tumor and dyspituitarism.

The encephalogram showed marked changes. The lateral ventricles were widely dilated and incompletely drained, the posterior two-thirds of the third ventricle was slightly dilated and the anterior one-third was encroached upon and retrodisplaced. The cisterna chiasmatis was completely obliterated and the subarachnoid spaces were lacking.

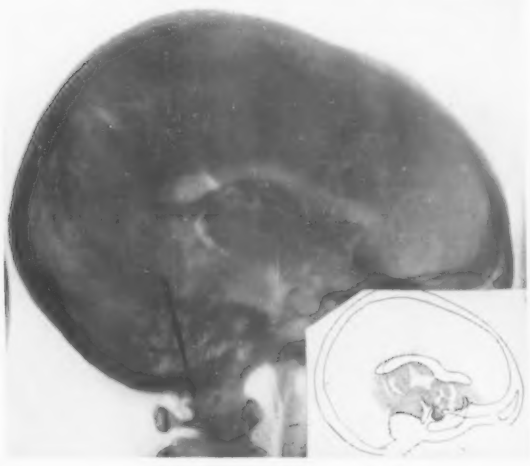

Fig. 8. Case viii. Glioma of the optic chiasm. The lateral and third ventricles are normal. The cisterna chiasmatis is visualized. The infundibulochiasmal shadow is widened. Visible cerebral sulci are reduced in number.

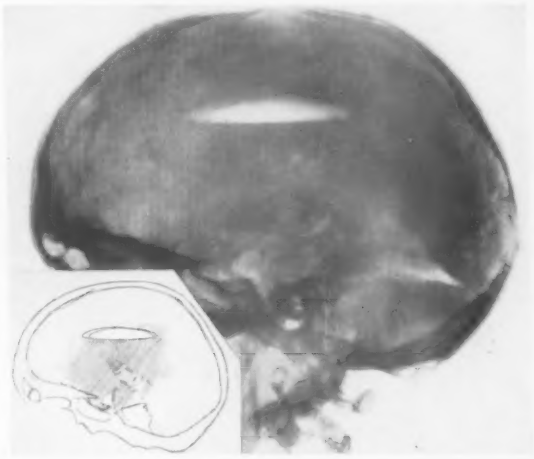

Fig. 9. Case ix. Suprasellar arachnoid cyst. The lateral ventricles are dilated and incompletely drained. The third ventricle is retrodisplaced, with an anterior filling defect. The cisterna chiasmatis is obliterated. The cerebral sulci are not visualized.

Operation disclosed a large, gray, subchiasmal arachnoid cyst.

The following case is presented to demonstrate the value of a negative encephalographic examination in cases of suspected suprasellar tumor. The clinical findings caused a suprasellar tumor to be suspected. Encephalography denied its presence and exploration confirmed the encephalographic finding.

Case x. A woman, aged forty-one, had for two years gained weight (40 pounds). The menses were decreasing and the patient had "hot flashes," visual failure especially in the left eye and somnolence without polydypsia or polyuria. For six months she had had a dull left frontal headache without nausea or emesis. She had anosmia without loss of taste. The patient was obese and had the appearance of one with mild myxedema. The optic discs were pale, without edema. Visual acuity was, O.D: 6/20, O.S: 6/60. Visual field examination showed a slight right temporal field defect. Skull roentgenograms were normal, as were the laboratory tests. The clinical diagnosis was suprasellar tumor.

The patient was kept under observation for two weeks during which time the discs became

edematous, with the appearance of low grade secondary optic atrophy. The spinal fluid pressure was 240 mm. of normal spinal fluid.

The encephalogram revealed a normal ventricular system, with marked development of the posterior horns. The cerebral sulci and basal cisterns were normally outlined. No evidence of a space-filling lesion was found.

Her convalescence was uneventful, but two months later, further visual failure and disc haziness prompted exploration of the chiasmal region.

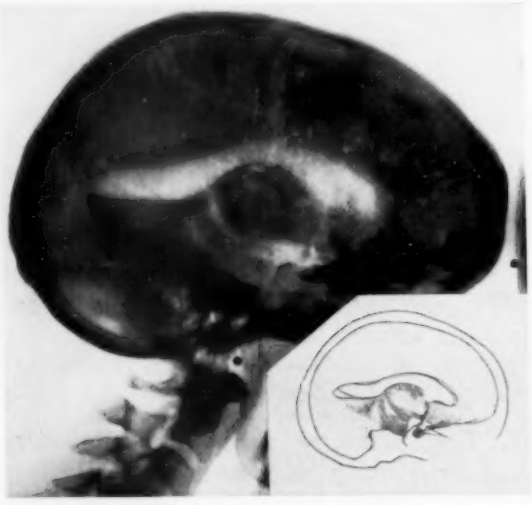

FIG. 10. Case X. Normal encephalogram. In this case a suprasellar tumor was suspected from the clinical syndrome. An encephalogram denied its presence and operation failed to disclose a lesion. The posterior horns are increased in size.

Through a left transfrontal approach the chiasmal region was thoroughly explored. A very satisfactory exposure was obtained, and no tumor, arachnitis or other abnormality was found to explain the patient's visual or olfactory symptoms. Her convalescence was uneventful. After a fluctuating course under glandular therapy, she is now, two years after operation, free of symptoms, with greatly improved visual fields, although the discs appear more atrophic than when she was first seen.

ENCEPHALOGRAPHIC CHARACTERISTICS OF SUPRASELLAR TUMORS

Although 9 cases is a small series from which to attempt to draw conclusions, they indicate that tumors in the suprasellar region may be visualized by encephalography and that negative plates are helpful in excluding the presence of this type of lesion. It seems also that the different tumor types present some different encephalographic features.

Suprasellar Tumors in General. The finding most common to all these suprasellar tumors was a more or less complete obliteration of the cisterna chiasmatis. Air was present in the cisterna pontis up to the level of the posterior clinoid processes in the majority of cases, but the lesion prevented the air from reaching the chiasmal cistern. The only case not exhibiting this phenomenon was Case VIII in which there was a small glioma of the optic chiasm. This tumor had not yet reached the stage of gross tumefaction, so was not large enough to block the cistern. Diminution of the cerebral subarachnoid markings, particularly in the frontal area, is another common finding, and is a direct consequence of the obliteration of the chiasmal cistern.

Distortion of the ventricular shadows depends upon the size and location of the tumor. The fourth ventricle and aqueduct filled in all instances. The third ventricle suffers frequent antero-inferior encroachment, the extent depending upon the size of the tumor. If the tumor is large enough, it will completely or incompletely block the foramina of Monro, with a resulting hydrocephalus.

While no rules can be established, it has seemed to us that certain of these abnormal findings indicate some tendency of the various types of suprasellar tumors to present different encephalographic features.

The Craniopharyngiomas. Symmetrical hydrocephalus of the lateral ventricles was noted in Cases I and III, possibly because craniopharyngiomas tend to extend upward more than do the meningiomas and gliomas of the optic chiasm, blocking the foramina of Monro. This was seen also in Case IX in which there was a suprasellar arachnoid cyst. The lateral ventricles in these cases drained incompletely.

Table I

	Lateral Ventricles	Third Ventricle	Cisterna Chiasmatis	Cerebral Subarachnoid Spaces
Case I. Craniopharyngioma	Widely dilated, incompletely drained	Markedly retrodisplaced and compressed to a flat band	Obliterated	Not filled
Case II. Craniopharyngioma	Negative	Negative	Obliterated. A rounded mass, 2 cm. in diameter, outlined above and anterior to sella	Markedly diminished, especially in right frontal area
Case III. Craniopharyngioma	Dilated. Anterior horns appear elevated	Dilated laterally, displaced upward and compressed to a narrow band	Small amount of air. A large filling defect is present	Practically normal
Case IV. Craniopharyngioma	Negative	Displaced upward, a 2.5 cm. filling defect below	Small amount of air, laterally. A rounded 2.5 cm. filling defect outlined over sella	Practically normal
Case V. Suprasellar meningioma	Convex filling defect in floors of anterior horns	Convex filling defect in anterior $\frac{1}{3}$. Posterior $\frac{2}{3}$ normal	Obliterated. An ovoid, 2×3 cm. filling defect, indistinctly outlined over the eroded sella	Markedly diminished
Case VI. Suprasellar meningioma	Elevation floors both anterior horns	Negative	Obliterated. An ovoid, 2×3 cm. filling defect, outlined just anterior to sella	Diminished, especially in frontal areas
Case VII. Glioma optic chiasm	Negative	Well drained, floor slightly elevated	Obliterated. A rounded 2.5 cm. filling defect, outlined above sella	Normal
Case VIII. Glioma optic chiasm	Negative	Negative	Clear. The infundibulochiasmal shadow appears thicker than usual	Uniformly diminished
Case IX. Suprasellar arachnoid cyst	Widely dilated, incompletely drained	Posterior $\frac{2}{3}$ slightly dilated. Anterior $\frac{1}{3}$ encroached upon and retrodisplaced	Obliterated	Absent

All these encephalograms were done under avertin anesthesia with the patient in the sitting position. The aqueduct and fourth ventricle were normal in all 9 cases.

The third ventricle showed an antero-inferior filling defect (Cases I, III and IV) that extended up to the foramina of Monro in Cases I and III; in Case II it was normal. This tumor (Case II) was small, so it did not encroach upon the ventricles as much as did the other two craniopharyngiomas.

The chiasmal cistern was obliterated in all 4 of these cases and the frontal cerebral subarachnoid spaces were abnormally diminished in Cases I, II and III.

Suprasellar Meningiomas. These tumors, originating from the tuberculum sellae, tend to lie further forward than do the

craniopharyngiomas. Consequently in Cases V and VI, there were filling defects in the slightly elevated floors of the anterior horns of the lateral ventricles. The third ventricle and foramina of Monro were not obstructed, so hydrocephalus was present in neither case. The third ventricle showed an antero-inferior filling defect in both cases.

Arising as they do under the cisterna chiasmatis, elevating and retrodisplacing it as they increase in size, the meningiomas particularly should tend to be outlined by air in the cisterna. Both Cases V and VI were so visualized. This finding is not pathognomonic of a meningioma, however, as a small subchiasmal craniopharyngioma (Case II), and the nodular glioma of the optic chiasm (Case VII) were both so outlined. The difference in the position of the tumors should be helpful; the meningiomas lie more anteriorly and may elevate the anterior horns of the lateral ventricles.

Gliomas of the Optic Chiasm. Unfortunately, our 2 cases of glioma do not lend themselves to good differentiation from other tumors in this region. Case VII was complicated by also invading the infundibulum, so showed only the characteristics of any suprasellar tumor, more especially those of a craniopharyngioma.

Case VIII was interesting in that the diagnosis might have been made by exclusion. The patient's only symptoms definitely indicated a chiasmal lesion. The encephalogram showed none of the characteristics of a space-filling lesion in that region except *an increase in size of the infundibulo-chiasmal shadow.* This may be a distinct characteristic of the lesion, but this can be determined only after more cases have been observed.

Other Tumors in the Region of the Sella. In Case IX an arachnoid cyst was not differentiated from any other suprasellar tumor encroaching on the third ventricle and partially obstructing the foramina of Monro.

Suprasellar extensions of pituitary tumors and third ventricle tumors have previously been analyzed and should not be confused with these lesions.

Olfactory groove meningiomas may obliterate the anterior part of the cisterna chiasmatis, but the greater upward and backward displacement and separation of the anterior horns of the lateral ventricles, together with the clinical syndrome, should help in differentiating them from suprasellar tumors.

SUMMARY AND CONCLUSIONS

1. The encephalographic characteristics in 9 cases of tumors of the suprasellar region are described. The series includes 4 craniopharyngiomas, 2 suprasellar meningiomas, 2 gliomas of the optic chiasm and 1 arachnoid cyst. The tumors were verified at operation.

2. The characteristic findings in these encephalograms of suprasellar tumors are: (*a*) obliteration of the cisterna chiasmatis, (*b*) diminution of the frontal cerebral subarachnoid spaces and (*c*) more or less encroachment upon the ventricular system.

3. The different tumor types appear to present some differential features. (*a*) The craniopharyngiomas showed, in addition to the above, an antero-inferior filling defect in the third ventricle and more or less obstruction of the foramina of Monro with resulting hydrocephalus. (*b*) The meningiomas showed in addition to the general features, outlining of the superior border of the tumor with less compression of the third ventricle. Filling defects were noted in the floors of the anterior horns of the lateral ventricles.

4. The gliomas of the optic chiasm await further observations for the establishment of a clear conception of their characteristics. The increased size of the infundibulo-chiasmal shadow in a normal cisterna chiasmatis, in a patient having a syndrome indicative of chiasmal damage, seems suggestive of a chiasmal glioma.

5. The outline of a normal chiasmal cistern on the encephalogram excludes the possibility of a surgical lesion in this region.

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ROENTGEN STUDIES ON THE FATE OF CALCIUM IN THE BONES OF RETAINED DEAD RABBIT FETUSES*†

AN EVALUATION OF "DECALCIFICATION" AS A ROENTGENOGRAPHIC DIAGNOSTIC CRITERION OF DEATH OF THE FETUS IN UTERO

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IN 1923 Séjournet[3] reported a case of a six months' pregnancy in which fetal skeletal shadows could not be made out in the roentgenograms, and in 1924 Portes and Blanche[1] reported two additional six months' pregnancies which did not show roentgenographic evidence of fetal bones. All three fetuses were subsequently proved to be dead and macerated, and Portes and Blanche concluded that the failure of the bones to show in the prepartum roentgenograms was due to decalcification incident to maceration.

In a recent publication from this laboratory, Schnitker, Hodges and Whitacre[2] restudying all of the known roentgen signs of fetal death** were impressed with the variety of factors that might produce a faint shadow of the fetal bones and questioned whether the case for decalcification was really proved.

The present paper records an attempt to determine by experiments on animals whether or not the roentgenographic shadows of the bones of a retained dead fetus become fainter as maceration progresses. It is recognized that there may be differences between the maceration of animal fetuses and that occurring in human subjects and furthermore that the artificial conditions of the experiment may differ significantly from those encountered in clinical obstetrics. These objections seem no more pertinent here, however, than in many other fields of medicine where animal experimentation has proved its worth.

Preliminary Experiments. Preliminary experiments on 14 guinea pigs, 1 dog and 8 rabbits demonstrated that for this work dogs were less suitable than rabbits because their thicker abdomens required longer exposure for the roentgenograms thereby increasing the likelihood of blurred image due to movement of the fetus. Guinea pigs were found unsuitable because of their high operative mortality.

Selecting Optimum Phase of Gestation. Breeders who regularly supply animals to the University's laboratories had asserted their ability to provide pregnant rabbits with the duration of gestation known exactly. It soon became obvious, however, that they were far from infallible (certain females declared to be at about term were not pregnant at all) and that the only sure means of selecting animals was to take those in which one or more fetal skulls could be palpated, make roentgenograms of the abdomen at intervals and perform the fetus-killing operation when the roentgenograms indicated that calcification of the skeleton was sufficiently progressed.

The best time for the operation appears to be about the twenty-fifth day of gestation. The bones are small and only slightly calcified on the nineteenth day and parturition occurs at about the thirtieth day.

Nature of Operation. Numerous methods of killing the fetus were devised and tested with the result that intrauterine manipulation of any sort such as ligation of the um-

** Alleged criteria include decalcification of fetal bones, angulation of fetal spine and overlapping of fetal skull bones. The genuinely significant criterion is a fetus disproportionately small for the duration of gestation.

* From the Division of Roentgenology, Department of Medicine, University of Chicago. Read before the American Congress of Radiology, Chicago, Ill., Sept. 25–30, 1933.

† This research problem was aided by grants from the Rockefeller Foundation and the Rosenwald Fund.

bilical cord or injection of lethal substances into the fetal brain or heart was abandoned because it invariably resulted in rupture of the uterus and usually in death of the adult animal as well as the fetus.

Ligation of Uterine Horn. If a loose ligature is placed about the uterine horn just below the uppermost fetus and the noose is made with a diameter of about 7 mm., there is no damage of the uterus but the fetus cannot be born (Fig. 1). This method alone was employed in some of the cases and it was observed that though the fetus usually continued to develop normally until the onset of labor, it did die then, presumably because contraction of the uterus caused separation of the placenta.

Ligation of the Placental Vessels. It was desirable to kill some of the fetuses at the earlier stages of skeletal calcification. Ligation of the placental vessels accomplishes the desired result (Fig. 1). The uterine wall of the pregnant rabbit is fairly translucent and it is not particularly difficult to make out the exact location of the placenta belonging to the uppermost fetus in the horn —that is, the one farthest removed from the vagina.

Inspection of the blood vessels in the mesentery of the uterus shows that the blood supply of the placenta is independent of the vessels to the uterine wall. Ligation of these placental vessels kills the fetus promptly but does not induce labor, kill the adult animal or injure even a small segment of uterine wall. Unlike ligation of the horn, placental vessel ligation cannot be used alone because with the onset of labor the dead fetus is born along with the others. Even if the onset of labor is prevented by ligating the placentas of all the fetuses present,* the dead fetuses are lost rather rapidly as maceration proceeds because the bones and other débris migrate out through the cervix into the vagina. Horn ligation is therefore an essential procedure. Employed alone the fetus usually does not die until parturition occurs. Accompanied by placental vessel ligation fetal death occurs promptly.

* Unpublished work in progress in this laboratory.

Details of the Operation. Under ether anesthesia (thirty minutes before operation 0.0004 grams atropine sulphate given intramuscularly) a midline skin incision is made, the mammary glands are pulled to either side and a 3 inch opening made in the peritoneum. The uterine horns containing usually from eight to ten fetuses are identified and the uppermost fetus on either side is brought through the abdominal opening. After ligating placental vessels or uterine horn or both, the uterine horns are allowed to fall back into the abdominal cavity and the wound is closed with catgut that catches peritoneum and muscles as a single layer. Black silk thread is used to close the skin. Standard aseptic technique is observed throughout the operation and a collodion dressing is applied to the wound. After some practice the entire operation can be completed in about twelve minutes.

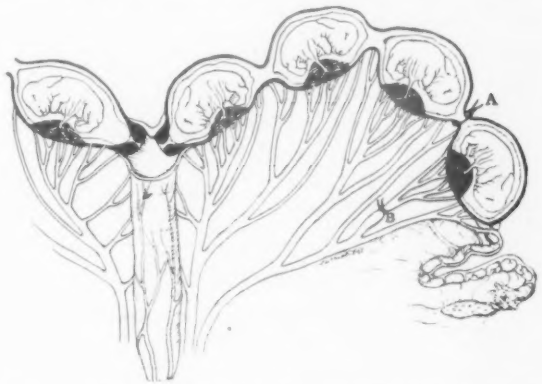

Fig. 1. Artist's sketch of left uterine horn of one of the rabbits. *A* represents a loose ligature encircling the uterine horn at the node between the uppermost fetus and its neighbor. At point *B* in the mesentery another ligature cuts off the blood supply to the uppermost placenta but does not affect circulation in the uterine wall. The sketch shows only the arteries. Actually arteries and veins travel together and both are caught in the ligature.

Forty-four Rabbit Experiments. After the preliminary work had demonstrated that rabbits were suitable animals for the experiment and had taught a means of killing a fetus and yet causing it to be retained in the uterus after the rest of the litter had

FIG. 2. Demonstration that Ligation of Placental Vessels Kills Fetus. (See also Figures 3 and 4.) Case 5, rabbit No. 60. Animal supine. Pregnant rabbit at nineteenth day of gestation. Fetal bones barely discernible.

been born, the way was clear to make serial roentgenograms of retained dead fetuses and note what happened to the bones.

Forty-four pregnant rabbits were used in this part of the work. Sixteen survived the operation for a period of from two months to a year. Three, though dying shortly after operation, have special interest and are therefore included in the abstracted case records. The remaining 25 animals died either under anesthesia or shortly after operation.

ABSTRACTS OF NINETEEN CASES

Group I

Five Cases in Which Placental Vessels Were Ligated on One Side, Horn Ligated on Both Sides

CASE 2. Rabbit No. 51. Operation 5.31.32—about twenty-eighth day of gestation. Right: Horn ligated. Left: Placental vessels ligated. Horn ligated.

Parturition 6.3.32—three days postoperative.

Death 8.15.32—two and one-half months postoperative.

Infection present. No evidence of decalcification of fetal bones either side.

CASE 3. Rabbit No. 53. Operation 5.31.32—about twenty-eighth day of gestation. Right: Horn ligated. Left: Placental vessels ligated. Horn ligated.

Parturition 6.3.32—three days postoperative. Birth of part of the litter. Retention of four fetuses including the two that were tied in.

Death 6.16.32—ten days postoperative.

Only the two ligated fetuses remain, the other two having been lost through the vagina unnoticed. The left fetus, killed promptly by vessel ligation, is smaller than the right fetus, which grew during part or all of the three days elapsing between horn ligation and onset of labor. No decalcification of fetal bones either side.

CASE 4. Rabbit No. 56. Operation 5.31.32—about twenty-seventh day of gestation. Right: Placental vessels ligated. Left: Horn ligated.

Parturition 6.3.32—three days postoperative.

Roentgenogram 12.15.32—seven and one-half months postoperative. Right: Fetus rather low in abdomen and on palpation cannot be displaced. Except for this would diagnose intraperitoneal fetus because of retained body shape and "curled-up"

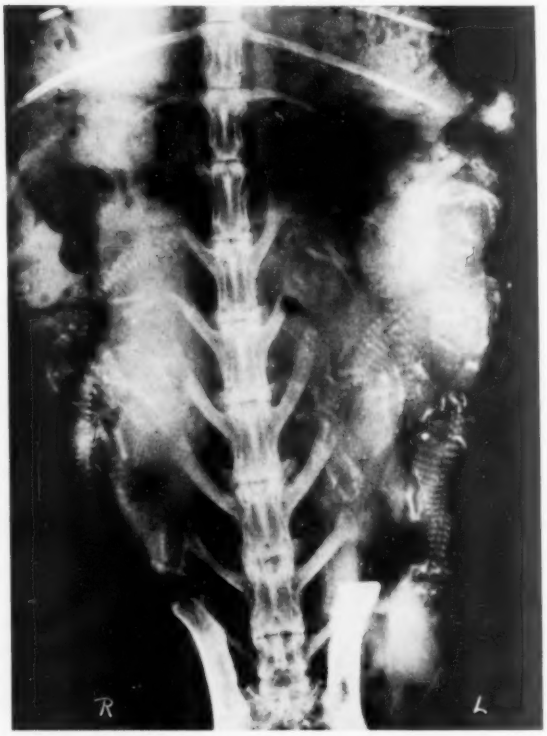

FIG. 3. Case 5, rabbit No. 60. Animal supine. Twenty-third day. Eight live fetuses. On this date vessel ligation of end (uppermost) fetus on right, second fetus from end on left. Horn ligatures placed retaining all three.

position. No decalcification. Left: Fetus "curled-up" and freely movable on palpation. Body shape retained. No decalcification of bones.

Secondary operation 12.19.32. Right: Fetus in its amniotic sac lies entirely in the peritoneal cavity but adhesions to the outer end of the right uterine horn prevent free migration. Left: Fetus free in peritoneal cavity.

Roentgenogram 1.28.33. Right: Same as on 12.15.32. Left: Same as on 12.15.32.

Death 5.9.33. Animal killed at end of experiment.

Autopsy. Right: Fetus in abdominal cavity adherent to right uterine horn. Small adhesions to mesentery. Left: Fetus free in peritoneal cavity. No adhesions. Body form retained. Roentgenogram shows bones of both fetuses not decalcified.

Case 5. Rabbit No. 60. Roentgenogram 5.16.32—about nineteenth day of gestation. Fetal bones barely discernible.

Operation 5.20.32—about twenty-third day of gestation. Right: Placental vessels ligated. Horn ligated. Left: Horn ligated to include the *two* upper fetuses. Placental vessels to uppermost fetus ligated.

Roentgenogram 5.20.32—the day of operation. Eight small fetuses faintly but definitely visualized.

Parturition 5.27.32—seven days postoperative.

Roentgenogram 5.27.32—immediately after parturition. Right: Fetus has not grown. Left: Fetus with ligated placental vessels has not grown. The other one has reached approximately full development.

Death 5.29.32. Cause unknown.

Autopsy. The fetus with intact placental vessels is approximately one and one-half times as large as the one in which the placental vessels were tied.

Case 6. Rabbit No. 72. Operation 6.16.32—approximately twentieth day of gestation (exact day of parturition not known). Right: Placental vessels ligated. Horn ligated. Left: Horn ligated.

Roentgenogram 6.16.32—day of operation. Fetal bones small; faint but definitely seen; right better than left.

Parturition—exact date not known, probably about 6.26.32.

Roentgenogram 7.25.32. Left: The fetus with intact placental vessels has reached maturity and lies high in the abdomen.

Roentgenogram 10.6.32. Right: No fetal bones seen.

Death 11.1.32—four and one-half months postoperative. Killed for observation.

Autopsy 11.1.32. Right: Horn ligature has produced complete obstruction and as a result marked hydrops of the horn has occurred. Examination of the unopened uterus yields no evidence that it contains fetal bones. Left: Fetus free in peritoneal cavity.

Roentgenograms of autopsy material: (1) Small disarticulated bones faintly seen within fluid-filled right uterine horn. Left fetus removed from peritoneal cavity. Little or no maceration. Bones appear fully developed. (2) After dissecting the uterine horn longitudinally and removing fluid, the extremely small, faint disarticulated bones are better seen. (3) The same bones removed from the uterus.

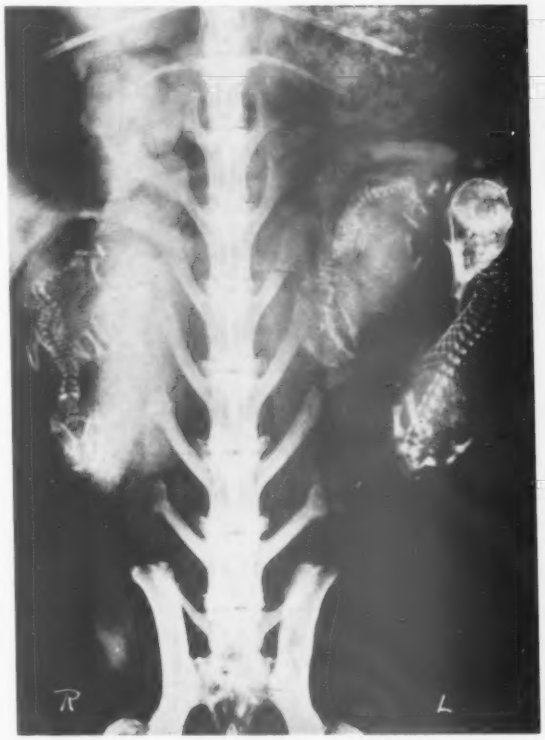

Fig. 4. Case 5, rabbit No. 60. Animal supine. Appearance immediately after delivery (seven days postoperative). Vessel-ligated fetuses have died promptly. (Their skeletons have not increased in size.) Upper fetus on left has continued to grow but, retained by horn ligature, has died during parturition.

Note: It is by no means certain that the fetus seen in the right half of the abdomen in "1" is the one whose bones were later removed from the right uterine horn. On the contrary, these bones are so small that they might well be masked by maternal parts.

Group II

Seven Cases in Which Horn Ligation Alone Was Done

Case 1. Rabbit No. 6. Operation 4.25.32—about twenty-eighth day of gestation. Right and left: Horns ligated.

Parturition 4.27.32—three days postoperative.

Roentgenogram 4.27.32—day of parturition. 5.16.32—nineteen days postoperative. 6.16.32—forty-nine days postoperative. 7.23.32—three months postoperative. 9.8.32—four and one-half months postoperative.

FIG. 5. Typical Instances of Normal Intrauterine Maceration. (See also Figures 6, 7, and 8.) Case 1, rabbit No. 6. Animal prone. Two full-term fetuses two days after death. Horn ligature used alone. Death due to placental separation at parturition.

A typical illustration of the body break-up and disarticulation that accompany intrauterine maceration.

Death 9.8.32—four and one-half months postoperative. Animal killed for observation. No evidence of infection. Right and left: Both fetuses show extensive maceration of soft tissues with distribution of disarticulated bones along the uterine horns and into the vagina. Unlike Case 6 the horn ligature while preventing free egress of solid material has not completely occluded the lumen. As a result of this there has been no hydrops and small bones have been lost through the vagina.

Roentgen examination of autopsy material. Films show distribution of disarticulated bones along the horns and in the vagina.

CASE 7. Rabbit No. 101. Operation 4.25.32—twenty-sixth day of gestation. Right and left: Horns ligated. Vessels not ligated.

Parturition 4.29.32—four days postoperative.

Roentgenogram 4.25.32—fetuses small. 5.4.32—larger than at ligation but smaller than full term. 6.1.32—beginning break-up both sides. 7.23.32—progressive break-up. 10.5.32—progressive break-up.

Death—five and one-third months postoperative.

Autopsy. There has been extensive infection. Both fetuses completely skeletonized.

Roentgen examination of autopsy material. Bones though disarticulated are not decalcified.

CASE 9. Rabbit No. 103. Operation 4.28.32—twenty-sixth day of gestation. Right and left horns ligated. Vessels not ligated.

Parturition 5.2.32—four days postoperative.

Roentgenogram 5.4.32—both fetuses much larger than on day before operation but smaller than full-term. 5.9.32—fetuses at least as large as three days ago, possibly larger. Have they continued to grow after the rest of the litter was extruded? 5.14.32—beginning break-up both sides. 5.21.32—one fetus has disappeared. 6.1.32—one fetus well seen left side of abdomen; the other cannot be seen. 6.16.32; 9.8.32—both fetuses have not disappeared.

Death 9.8.32—four and one-half months postoperative. Animal killed for observation. At autopsy both uterine horns of about normal size. The black silk ligatures, though still present, do not occlude the lumen. Apparently they have gradually cut through with re-establishment of the lumen behind them.

Roentgen examination 9.8.32. Autopsy material—no evidence whatever of fetal bones. Obviously par-

FIG. 6. Case 1, rabbit No. 6. Animal supine. Nineteen days after fetal death. Note beginning skeletal break-up in left fetus.

tially macerated fetuses were lost through the vagina.

Case 12. Rabbit No. 113. Operation 4.25.32—twenty-second day of gestation. Right and left horns ligated. Vessels not ligated.

Parturition 5.3.32—eight days postoperative.

Roentgenogram 5.4.32—three fetuses retained. All have reached about full-term development. 5.11.32—beginning break-up fetuses right side. Retention of body form left side. 7.25.32—three months postoperative. Right: Fetuses extensively broken up right side. Loss of some bones from these fetuses. Others scattered through uterus. Left: Fair retention of body form. Fetus high in maternal abdomen. 12.15.32—seven and three-quarter months postoperative. Right: Disarticulated but normally calcified bones collected into a firm mass in the right uterine horn. Left: Body form fairly well retained but pelvis, extremities and head curled up in position typical of a fetus free in the peritoneal cavity. Note: This fact confirmed by palpation. Fetus can be moved freely to any desired point in the peritoneal cavity. 2.23.33—findings same as of 12.15.32.

Killed 2.23.33. Left: Fetus intraperitoneal. Removed under aseptic conditions and placed in abdominal cavity of rabbit No. 64, Case 43. After two and one-half months fetus recovered from abdominal cavity of rabbit No. 64 and on roentgen examination no decalcification could be seen in the bones. Right: Some of the bones of two fetuses were recovered from right uterine horn. Bones completey skeletonized and many had been lost through the patent uterine horn. Roentgen examination showed these retained bones to be of normal density.

Fig. 7. Case 1, rabbit No. 6. Animal supine. Appearance after four and a half months of maceration. The fetus on the right is still further broken up; the one on the left is completely skeletonized and some of the bones have escaped through the horn ligature. No decalcification.

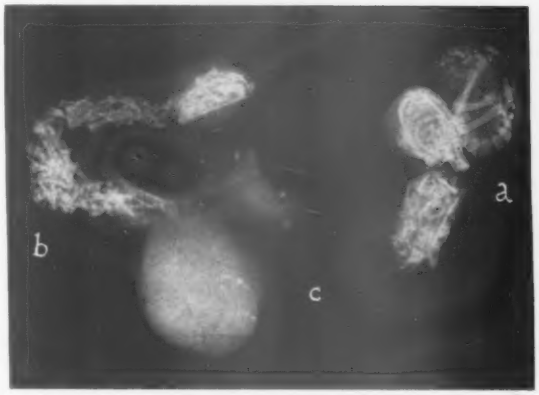

Fig. 8. Case 1, rabbit No. 6. Autopsy material. *a*, right uterine horn; *b*, left uterine horn; *c*, vagina. Disarticulated bones scattered through uterine horns and vagina. No decalcification. Illustration of loss of individual bones through uterine horn in spite of ligature. The right-horn ligature has been tight enough to prevent escape of any of the bones but on the left a few small bones have got through into the vagina. This is the process which in the case illustrated by Figure 16 resulted in the loss of most of the bones and produced one case of pseudo-decalcification.

Case 13. Rabbit No. 116. Operation 4.25.32—about twenty-sixth day of gestation. Right and left horns ligated. Vessels not ligated.

Parturition 4.29.32—four days postoperative.

Roentgen examination 4.25.32—fetuses extremely small. 4.30.32—four fetuses instead of two remain. 5.31.32—thirty-six days postoperative. Four fetuses present; much larger than at date of operation. 6.16.32—right: Extensive break-up of body. Left: Two fetuses, bodies intact. Fourth fetus barely visible high in abdomen. 10.3.32—five months postoperative. Still further break-up of the fetus in the *right* uterine horn. Three free intraperitoneal fetuses.

Death 11.1.32—six months postoperative. Animal killed for study.

Autopsy. Three fetuses free in the peritoneal cavity. Two entirely without adhesions, the third slightly adherent to the small intestine. The disarticulated bones of the fourth fetus lie in the right horn of the uterus.

Roentgen examination of autopsy material. (1)

The three intraperitoneal fetuses characteristically curled within their amniotic sacs have bones of normal density. The disarticulated bones of the fourth fetus are retained in one of the uterine horns. The skull, completely separated from the rest of the body, has migrated to a narrow point in the horn and appears to be of normal density. The other bones surrounded by fluid are distinctly less dense than the skull and the bones of the fetuses recovered from the peritoneal cavity. (2) Macerated bones compared with skeletons of the intraperitoneal fetus. No de-

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FIG. 9. Absence of Decalcification after Long-Continued Intrauterine Maceration. (See also Figures 10, 11 and 12.) Case 8, rabbit No. 102. Two full-term fetuses killed by vessel ligation. Appearance ten and a half months after death. Right-horn fetus extruded into peritoneal cavity retains its body form. Left-horn fetus has undergone intrauterine maceration. Both skeletons retain their normal density.

calcification. (3) Dissected bones from fetus macerated in the uterus and one of the peritoneal fetuses. The two sets of bones are about equal in density.

CASE 14. Rabbit No. 122. Operation 4.26.32—approximately sixth day of gestation (estimation based on size of gestation sac). Right: Two small gestation sacs present in the right horn. Horn ligated distal to the lower sac. Vessels not ligated. Left: Horn of normal size. No evidence of gestation sac on that side.

Parturition did not occur. Normally due about 5.20.32.

Roentgen examination 5.24.32—twenty-eight days postoperative. Single fetus at about term lying on the left side of the abdomen. Presumably the right uterine horn has been free to move to the left side of the abdomen. 7.23.32—three months postoperative. The single fetus, now on the left of the abdomen, retains its body form as though it were intraperitoneal.

Death 8.7.32—three and one-half months postoperative.

Autopsy. Right: Ligature completely occludes the lumen; horn distended with pus. Fetus only slightly macerated.

Roentgen examination of autopsy material. (1) There has been no body break-up. The shape is practically the same as in the cases of intraperitoneal retention. Bones are not decalcified.

CASE 18. Rabbit No. 110. Roentgen examination 4.18.32—approximately eleventh day of gestation. No bones seen. 4.27.32—approximately twentieth day of gestation. Small fetal bones faintly seen.

Operation 4.29.32—four fetuses are present, two on either side. Right: End fetus has apparently died early in gestation (before calcification of the bones) and is undergoing absorption. Horn ligature placed to confine both this one and the one adjacent to it. Placental vessels not ligated. Left: Horn ligature placed to retain uppermost fetus. Placental vessels not ligated.

Parturition 5.5.32.

Roentgen examination 5.7.32—two fetuses are present. They are, of course, much larger than they were at the time of operation, in fact, so large as to suggest the possibility that they did not die during labor but continued to develop for a few days beyond that time.

Death 5.9.32, due to peritonitis.

Group III

Seven Cases in Which Vessel Ligation and Horn Ligation Were Done on Both Sides

CASE 8. Rabbit No. 102. Operation 4.28.32—thirtieth day of gestation. Right and left horns ligated. Placental vessels ligated.

Parturition 4.28.32—on the day of the operation.

Roentgen examination 5.4.32—six days postoperative. Animal prone. Right: Body form retained suggesting intraperitoneal location. Left: Definite body break-up. 11.21.32—six and three-fourths months postoperative. Animal supine. Right: Curled-up position typical of extrusion into the peritoneal cavity. Left: Extensive but peculiar type body break-up. The disarticulated bones instead of clumping into a formless mass are spread over a wide area. 12.15.32—seven and one-half months postoperative. About the same as on 11.21.32. Fetal bones not decalcified.

Exploratory operation 12.19.32. Right: Fetus intraperitoneal. Some adhesions to small intestines and omentum. Left: Fetus in large cystic uterine horn. Partially macerated. Some loss of body form.

Animal killed 5.9.33—at end of experiment. Right: Same as 12.19.32. Left: Partially macerated fetus in cystic left horn. Cystic fluid yellowish, no doubt products of soft tissue maceration. Bones can be picked from soft tissue with forceps. Body form retained grossly.

Roentgen examination of autopsy material shows fetal bones are not decalcified.

Case 11. Rabbit No. 109. Operation 4.25.32—about twenty-fourth day of gestation. Right and left horns ligated. Placental vessels ligated.

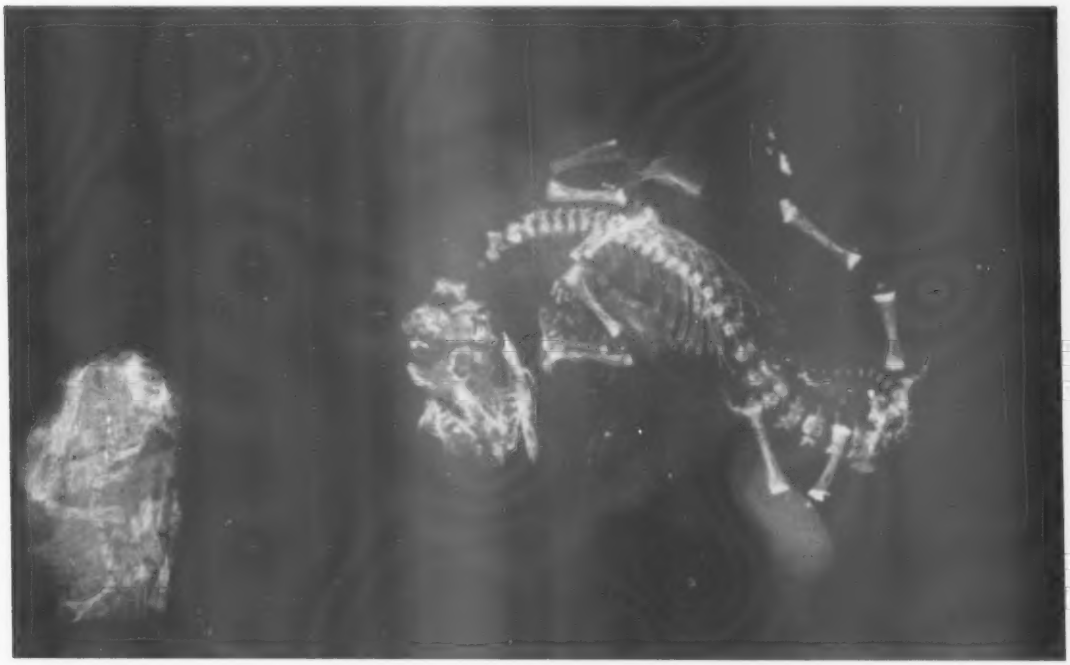

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Fig. 10. Autopsy material from same case as Figure 9. (Animal killed after carrying dead fetuses twelve and a half months.) Right-horn fetus was found lying outside of the uterus attached to peritoneum. Tissues not macerated but largely absorbed by invading blood vessels. Left horn: Delayed soft tissue maceration due to distention of horn by pus. No skeletal decalcification.

Case 10. Rabbit No. 105. Operation 4.28.32—twenty-seventh day of gestation. Right and left horns ligated. Placental vessels ligated.

Parturition 5.1.32—three days postoperative.

Roentgen examination. Fifteen examintions beginning before operation and continuing until eight months after operation show left fetus intraperitoneal and retaining its body form for a long period. Right fetus intrauterine and therefore undergoing complete skeletonization. Both fetuses are young and bones therefore are faint, but there is no evidence of decalcification.

Death of animal 1.1.33.

Autopsy findings. Left: Uterine horn entirely separated from body of uterus and distended with fluid. Fetus intraperitoneal and has no adhesions. Cannot make out place in uterine horn where fetus escaped. Right: Fetus intrauterine. Horn grossly distended with pus. All the soft tissue is liquefied but occasional shreds seen. Complete loss of body form. Bones scattered through fluid, completely separated from each other.

Roentgen examination of autopsy material shows bones not decalcified.

Roentgen examination 4.25.32—day of operation. Skeletons faint and small.

Parturition 5.2.32—seven days postoperative.

Roentgen examination 6.16.32—one and three-quarter months postoperative. At first glance would think fetus had grown. This is probably explained by the fact that adult animal now weighs less and the film technique is better.

Death 9.19.32—four and three-quarter months postoperative. Animal killed for study. Both fetuses intrauterine, one almost completely skeletonized; the other beginning to disintegrate. Bones not decalcified.

Case 15. Rabbit No. 124. Operation 5.6.32—

twenty-seventh day of gestation. Right and left horns ligated. Vessels ligated.

Parturition 5.9.32—three days postoperative.

Examination beginning before operation and continuing until after death demonstrated gradual break-up of fetal bodies but absence of decalcification. The high location in the abdomen suggested the possibility of intraperitoneal fetus.

Secondary operation 6.6.32—thirty days postoperative. Ventral hernia repaired. Uterine horns contain pus.

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FIG. 11. Case 16, rabbit No. 127. Roentgenogram of living rabbit carrying two twenty-eight day fetuses that have been dead ten and one-third months. Right horn: Typical disarticulation of normal intrauterine maceration. Left horn: Retention of body form typical of fetus extruded into peritoneal cavity. Normal skeletal density in both.

Death 7.5.32—presumably due to infection.

Autopsy. Both uterine horns full of pus. Fetal soft tissues partly liquefied. Bones not decalcified.

CASE 16. Rabbit No. 127. Operation 5.2.32—twenty-eighth day of gestation. Right and left horns ligated. Placental vessels ligated. Parturition 5.4.32—two days postoperative.

Roentgen examinations beginning before operation and continuing twelve and one-sixth months postoperative show: Left: Slow break-up of intraperitoneal fetus. Right: Complete skeletonization of intrauterine fetus. Bones not decalcified either side.

Exploratory operation 2.23.33. Right horn: Fetus intrauterine, almost completely skeletonized. Left horn: Fetus intraperitoneal. Attached by adhesions to left horn. Soft tissue almost completely resorbed. Fetus greatly shrunken in size, but bones in normal relation to each other. Possible early lithopedion.

Killed 5.9.33 at end of research experiment—twelve and one-sixth months postoperative. Right horn: Fetus intrauterine. Completely skeletonized. Left horn: Same as 2.23.33 except that fetus is shrunken to an even smaller size. Believe if animal had lived longer a lithopedion might have been the end-result of this fetus.

Roentgen examination shows that the bones of neither fetus are decalcified.

CASE 17. Rabbit No. 150. Operation 5.6.32—twenty-sixth day of gestation. Right and left horns ligated. Placental vessels ligated.

Parturition 5.10.32—four days postoperative.

Seven roentgen examinations beginning before operation and continuing until after death demonstrate that in addition to the two ligated fetuses three others were retained after parturition. By 6.1.32 the total retained fetuses were reduced to four. By 7.25.32, to three, which remained until death of the animal.

Death 10.5.32—five months postoperative. Animal killed for study.

Autopsy. Two fetuses free in peritoneal cavity. Disarticulated bones of the third retained in the uterine horn.

Roentgen examination of post-mortem material shows that the skeletonized bones in the uterine horn and those from the slightly macerated intraperitoneal fetus are of normal density.

CASE 19. Rabbit No. 80. Operation 1.27.33—thirtieth day of gestation. Left: End fetus tied in, placental vessels ligated. Right: No fetuses present in right horn.

Parturition 1.28.33. Two fetuses remain.

Roentgen examination 2.13.33—sixteen days postoperative. Two fetuses seen on left side close together. No beginning break-up. 3.11.33—forty-two days postoperative. Two fetuses left side. No loss of body form or beginning body break-up, hence both fetuses most probably intraperitoneal.

Animal killed 5.9.33 at end of research experiment, three and one-half months postoperative. Both fetuses that have ruptured through rent in left uterine horn are intraperitoneal. Fetuses are firmly bound together by an inflammatory tissue mass which is extensively vascularized. Both uterine horns appear normal.

Roentgen examination shows bones of fetuses are not decalcified.

Group IV

Twenty-five animals in this group died within a month of operation. In no case was there

evidence of decalcification of fetal bones. The period of observation was so short, however, that we considered it unnecessary to abstract the cases.

SUMMARY OF NINETEEN CASES

Table 1 summarizes the findings in the 19 cases that are abstracted. In 7 cases both uterine horns were ligated but placental blood supply was not disturbed. In 7 cases there was ligation of vessels as well as uterine horns on both sides. In 5 cases uterine horns were ligated on both sides, vessels on only one side. In 9 cases uterine tears occurred with the result that one or more fetuses escaped into the peritoneal cavity but in no instance did this accident appear to shorten the life of the adult animal.

Some of the fetuses that ruptured into the peritoneal cavity and remained there many months showed practically no maceration. Others that remained in the uterus underwent rapid maceration, terminating in complete liquefaction of all fetal tissue except the skeleton. In no instance did maceration appear to be accompanied by decreasing density of the fetal bones.

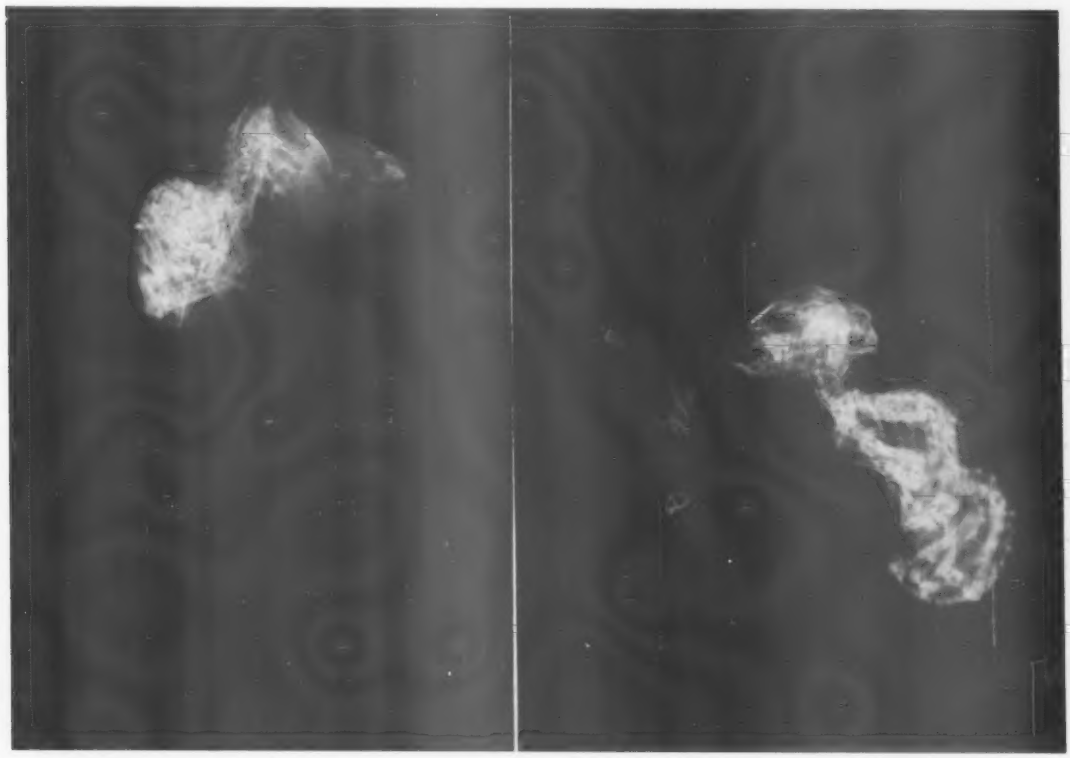

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Fig. 12. Same case as Figure 11. Autopsy material obtained two months later (twelve months after fetal death). Right-horn fetus: In the absence of gross infection, soft tissue maceration has been rapid and complete. (Compare with left-horn fetus, Fig. 10, where in the presence of pus maceration was greatly delayed and the skeleton retained a semblance of its normal shape.) Left-horn fetus: Because of its intraperitoneal location this fetus has not undergone maceration. It has, however, become adherent to the uterine horn and acquired a blood supply which has absorbed most of the soft tissue. Neither the macerated nor the unmacerated fetus shows any evidence of skeletal decalcification. Note migration of individual bones through intact horn ligature (right horn).

Pseudo-decalcification. Roentgenologists will not need to be reminded of the numerous technical details concerned in the sharpness and density of the roentgenographic images of fetal bones. Others probably have little conception of the exactness with which faulty machine settings, move-

TABLE I

Case Number	Rabbit Number	Uterine Horns Ligated Both Sides	Uterine Horns and Placental Vessels Ligated Both Sides	Uterine Horns Ligated Both Sides. Placental Vessels Ligated One Side	Rupture of Uterus with Extrusion of One or More Fetuses into Peritoneal Cavity	Autopsy	Number of Roentgen Examinations	Time Elapsed Between Death of Fetus and Latest Roentgen Examination	Bones Decalcified?
1	6	x				yes	13	7½ mo.	no
2	51			x		yes	6	2½ mo.	no
3	53			x		yes	4	13 days	no
4	56			x	x	yes	10	11⅓ mo.	no
5	60			x*		yes	4	7 days	no
6	72			x	x	yes	4	4⅘ mo.	no
7	101	x				yes	12	5¼ mo.	no
8	102		x		x	yes	15	12⅓ mo.	no
9	103	x				yes	10	4⅘ mo.	†
10	105		x		x	yes	15	8 mo.	no
11	109		x			yes	10	4¾ mo.	no
12	113	x			x	yes	11	9⅔ mo.	no
13	116	x			x	yes	11	6 mo.	no
14	122	x				yes	6	2 mo.	no
15	124		x			yes	8	2 mo.	no
16	127		x		x	yes	16	12⅙ mo.	no
17	150		x		x	yes	7	5 mo.	no
18	110	x				yes	3	5 days	no
19	80		x‡		x	yes	4	3½ mo.	no

* In Case 5 the left uterine horn contained two fetuses. The horn ligature retained both but only in the upper fetus were the placental vessels ligated.

† In Case 9 macerated fetuses lost through vagina due to failure of horn ligature.

‡ In Case 19 right horn was left undisturbed. Two fetuses were found in abdominal cavity at autopsy, both through rent in left horn.

ments of parts and scattering of radiation by interposed soft tissue can simulate general decrease in skeletal calcium. At least four conditions may simulate decalcification: (1) Blurred image due to respiratory movement. (2) Accidental and undiscovered loss of entire fetus through vagina as a result of failure of ligature (Fig. 14) or gradual loss of individual bones through the narrow construction beneath an intact ligature (Figs. 8, 16, 17). (3) Incompletely calcified bones of very young fetus mistaken for decalcified bones of an older one (Figs. 16 and 17). (4) Scattering of radiation by fluid surrounding or overlying a fetus (Figs. 17 and 18).

Soft tissue maceration. Most of the dead fetuses that remained in the uterus began to show roentgen evidence of skeletal break-up by the seventh day or earlier (Fig. 4), the process being usually quite extensive by the beginning of the second month. In those instances where skeletal break-up failed to occur, autopsy usually showed that the fetuses lay free in the peritoneal cavity, though in some instances it was found that they were in the uterus but that the horn was completely occluded and that considerable purulent material had accumulated. These findings lead to two somewhat conflicting conclusions:

1. Soft tissue maceration is most complete when the fetus lies in an approximately normal uterus in the absence of gross infection or stenosis of the lumen.

2. When the uterine horn in which the fetus

is retained becomes distended with cystic fluid, maceration progresses more slowly than in the normal horn and the delay is still greater when the horn is completely stenosed and filled with pus. Fetuses surrounded by an intact amnion and lying free in the peritoneal cavity resist maceration for long periods, perhaps indefinitely.

These two findings are hard to reconcile with the idea that maceration is primarily a putrefactive process. Perhaps they indicate that maceration is accomplished by rather specific organisms which are absent in the sterile peritoneum or are destroyed if the mild sepsis of the uterine horn gives way to frank collection of pus.

DISCUSSION

Fitness of Operative Procedure. In those cases where for some reason the ligature occluded the uterine horn completely, producing cystic dilatation, it might be argued that an impaired uterine circulation resulted in the loss of a specific osteolytic property. This argument, however, would imply that the uterus is provided with two macerating agents—one for soft tissue, another for bone—because the fetuses contained in cystic uterine horns suffered soft tissue maceration not as rapid but eventually quite as complete as in the animals where the ligature remained loose and the horn did not become cystic.

Fig. 13. Pseudo-decalcification. (See also Figures 8, 14, 15, 16, 17 and 18.) Case 9, rabbit No. 103. Two full-term dead fetuses retained by horn ligatures. Appearance five days after normal delivery of eight living animals.

Fig. 14. Case 9, rabbit No. 103. Five weeks later. Fetuses have disappeared. Subsequent autopsy shows ligatures cut through and horn lumen reestablished.

Ligation of placental vessels presumably kills placenta, chorion and amnion along with the fetus but, even so, conditions are probably not much different from those obtaining in the death of human fetuses. Exact information is lacking as to the fate of these structures when the human fetus dies because of knotting of the cord. It is known,* however, that with cessation of fetal circulation the blood supply to cho-

* Personal communication from Dr. Fred Adair.

R L

FIG. 15. Case 6, rabbit No. 72. Beginning skeletal calcification in nineteen-day fetuses. On this date vessel and horn ligation of right fetus; horn ligation alone of left fetus.

rion and amnion fails, so presumably death of the fetus, whatever the cause, affects the blood supply of amnion, chorion and at least the fetal half of the placenta about as effectively as does ligation of the placental vessels.

Duration of Observation. The longest period of intrauterine maceration observed in this series was a little over one year and in that time there was no skeletal decalcification of a grade that could be detected in roentgenograms. There is no assurance, of course, that the disarticulated bones will indefinitely resist disintegration. Turner,[4] however, basing his opinion on the study of slaughter-house material, believes that if the fetus of a cow dies after the skeleton has become ossified complete resorption is impossible. It seems reasonable to assume that twelve and one-half months of maceration in the rabbit is equivalent to a much longer period in human subjects. Direct comparison, of course, is impossible but the Table II shows some of the known time relationships between this laboratory animal and man.

The rate at which a simple fracture will heal or a living bone transplant be absorbed appears to depend upon so many factors that comparison between the rates in rabbits and humans is impossible. The problem of racial time factor can be avoided by using the completeness of soft tissue maceration as a gauge. In this respect the findings leave no room for doubt. Maceration amounting to complete liquefaction of all soft parts including cartilage left the fetal bones of rabbits intact. Unless there are specific differences between the rabbit and the human subject there is little reason to believe that moderate soft tissue maceration in the human fetus is accompanied by decalcification of the fetal skeleton.

R L

FIG. 16. Case 6, rabbit No. 72. Four months later. Intact full-term left-horn fetus. Almost total absence of skeletal shadows, right.

Table II

	Human	Rabbit	Ratio
Life span	70 yr.	7–8 yr.	1/10
Sexual maturity	12 yr.	1/2 yr.	1/24
Duration of gestation	9/12 yr.	1/12 yr.	1/9

SUMMARY

After perfecting a technique for killing rabbit fetuses shortly before parturition and assuring their retention in the uterus, 44 animals were studied by serial roentgenograms in the hope of demonstrating the decalcification of fetal bones that has been reported by certain French workers.

Nineteen animals were observed for from two to twelve and one-half months and in several of these fetal soft tissues became completely liquefied. In none, however, was there a decrease of bone density that could be explained as due to decalcification.

In some cases factors such as the collection of fluid in a cystic uterine horn or respiratory movement altered the roentgen appearance of the fetal bones, but in all such instances it was possible to demonstrate that the "decalcification" was spurious.

In those instances in which intraperitoneal fetuses became adherent to viscera or abdominal walls, vessels grew into the fetuses and eventually absorbed the soft tissues. This soft tissue absorption did not, however, produce break-up of the skeleton but instead caused the skeleton to shrink down into a small caricature of itself.

Retention in a healthy uterine horn was followed by soft tissue maceration and progressive skeletal break-up that could be detected in roentgenograms as early as the fifth day and reached a marked degree by the beginning of the second month. When complete stenosis of the horn occurred and pus accumulated, the rate of maceration was greatly delayed.

Fetuses that escaped into the peritoneal cavity carrying an intact envelope of amnion escaped maceration if they remained free and unattached. Even after six months of retention their tissues appeared normal on gross examination and microscopic examination showed only slight disintegration.*

In a few instances very young fetuses were observed at operation and later were found to have been completely absorbed, but in these cases the bones had not become calcified at the time the fetus died.

Fig. 17. Case 6, rabbit No. 72. *b*. Left-horn fetus: In the eleven days that have elapsed between horn ligation and parturition, this fetus attained full growth. At autopsy it was found free in the peritoneal cavity, surrounded by an intact amnion. The soft tissue is not macerated though the fetus has been dead approximately five months. *a*. Right-horn fetus: This fetus, killed by vessel ligation on the nineteenth day, has bones that are only slightly calcified. Many have been lost through the vagina during the interval before the horn became completely occluded at the site of its ligature. The shadows of remaining bones are blurred by scattering in surrounding cystic fluid.

* Encountered originally as an accidental complication following the standard operation, these intraperitoneal fetuses presented so much of interest that they were later produced deliberately in experiments not recorded here. The procedure is to tie off the uppermost fetus in the usual manner and then nick the uterine sac that encloses it. With the onset of parturition the sac tears and the fetus is extruded into the peritoneal cavity.

Regardless of the degree of soft tissue maceration or the duration of retention, fetal bones old enough to have become calcified remained calcified.

2. The alleged observations of disappearance of fetal bone shadows during the maceration of human fetuses are probably to be explained on technical grounds.

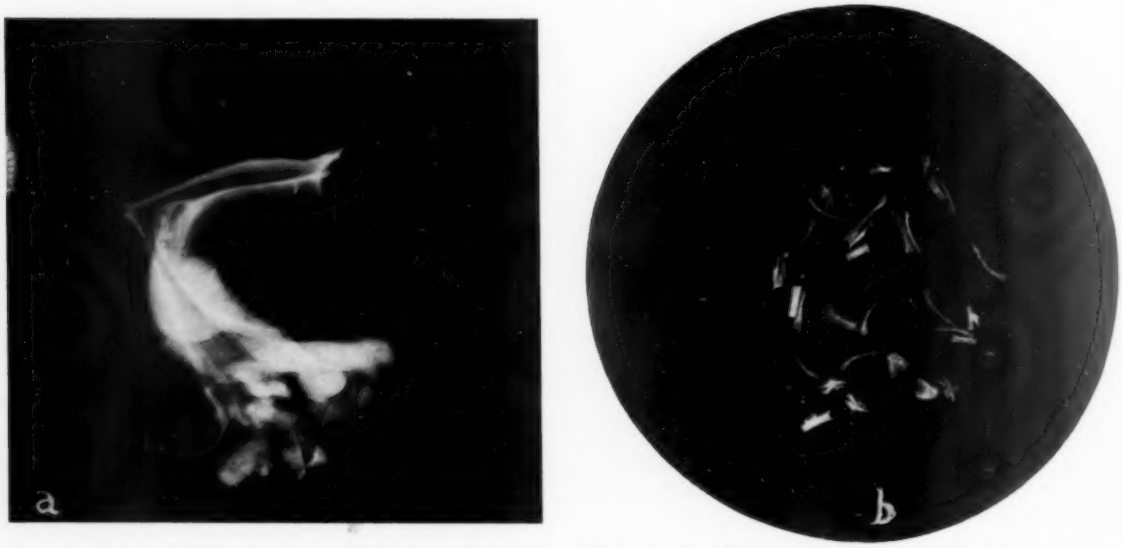

FIG. 18. Case 6, rabbit No. 72. *a*. Right horn laid open and drained of fluid, showing the small bones to better advantage. *b*. Bones roentgenographed after removal from the horn. The assumption that the missing bones have not suffered absorption but have been lost a few at a time through the vagina at a time when the horn obstruction was not complete is based on findings in other cases (Fig. 8) where that process was observed in serial roentgenograms.

CONCLUSIONS

1. The bones of a rabbit fetus once calcified do not lose their calcium, even though the fetus die and be macerated for as long as one year with resulting complete liquefaction of its soft tissues.

It seems safe to assume that the bones of a dead human fetus do not lose calcium during maceration and that "decalcification" should no longer be included among the roentgenographic criteria of fetal death.

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* The paper by Schnitker et al[2] includes 58 references, many of which bear on this question. All of the references to decalcification of fetal bones as a criterion of death of the fetus in utero can be traced back to the original publication of Portes and Blanche[1] and Séjournet.[3] It seems superfluous to list the others here.

Vol. 33, No. 1

ROENTGENOGRAPHIC STUDY OF GASTROINTESTINAL MOTILITY IN RACHITIC RATS*

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IT IS a matter of common observation by those engaged in any study of experimental rickets that during the depletion period of the bio-assay for vitamin D, the animals become constipated. Rachitic rats have been examined under the roentgenoscope by Menville, Blackberg and Ané[4,5] who have reported that such animals exhibit stomachs which are dilated and atonic, that the small intestine is apparently hypermotile and that the colon shows hypomotility. According to these authors, the retention of food in the stomachs of rachitic rats is definitely longer than that of non-rachitic control animals.

In our own laboratory, some time ago, in connection with another matter, certain unpublished roentgenographic observations of rachitic rats were made which fail to support entirely the conclusions of Menville et al., and we have now repeated their work with certain variations which seem to us to be improvements in technique.

There are differences between the methods of the above authors and those employed in our investigation. Menville and his coworkers used McCollum's rachitogenic diet for one group and a stock diet for the other; we used the Steenbock diet No. 2965 with or without a casein-sucrose diet; their induction period was "five or six weeks," whereas ours was either twenty-one or thirty-one days; Menville's animals were fed barium-buttermilk mixture ad lib. for twenty minutes and the weights of food consumed by different animals were variable, whereas we have preferred to give each animal a definite quantity which would be consumed completely in twenty minutes, and to discard any rats which failed to consume the entire test meal within this period of time; Menville's examinations were for the most part roentgenoscopic, while ours were by roentgenography which, although more time consuming, affords permanent records for subsequent analysis and comparison.

For our non-rachitic groups we have used the same diets as for the rachitic, but with added irradiated ergosterol, this having an advantage in that there is but one variable in each class. In the tests herein reported, therefore, we record motility of the gastrointestinal tract as influenced by the presence or absence of vitamin D and / or hydrogenated fat in each of two definite diets which were supplied over a fixed period of time preceding the observations. For the measure of motility, we have taken the time of passage of the last definite traces of barium test meal through various sections of the gastrointestinal tract.

PLAN OF THE EXPERIMENTS

The protocols of the work called for a comparison between rats on each of two types of rachitogenic diet, with and without antirachitic supplement administered as a curative or prophylactic dose, with and without added fat. Part I deals with the comparisons involving the presence or absence of rachitic condition; Part II deals with the comparison between fat-free, "normal" fat, and added fat in the diets in a rachitic condition of the animals; Part III offers a comparison between fat-free, "normal" fat, and added fat in a non-rachitic condition of the animals.

The letter A in each part refers to the use of fat-free basic diet, the letter B designates the use of the normal fat basic diet.

* Contribution No. 44 from the Department of Biology and Public Health, Massachusetts Institute of Technology, Cambridge, Mass.

In both A and B divisions, the basic diet was used alone, with added fat, and / or added vitamin.

GENERAL EXPERIMENTAL PROCEDURES

Each subdivision started with a group of 10 animals and a like number of controls. Certain control groups serve one or more test groups in common. One hundred animals were involved. The roentgen films number approximately one thousand.

The albino rats of Wistar strain were twenty-eight days old and averaged 55 grams in weight, were caged separately, and supplied water ad lib. at all times except as noted. At the end of the feeding period, water and food were removed for approximately twenty-four hours, each animal was then offered 2.0 grams of barium sulphate-buttermilk mixture (1:1), these feedings being spaced at intervals of about three minutes so that subsequent roentgenograms could be taken on schedule. Any animals which failed to entirely consume the test meal in twenty minutes were discarded from further observation. Of each animal which survived this elimination a roentgenogram was taken at twenty minutes, sixty minutes, and hourly thereafter until the sixteenth hour after the test meal had been offered, and subsequently whenever periodic roentgenoscopic examinations indicated a definite change in the picture of the passage of the test meal through the gastrointestinal tract. The films, each with its serial number and hour of exposure in silhouette, are the permanent record from which subsequent analyses have been made. Each recorded value represents an agreement between independent readings of these roentgenograms by both of us. Needless to say, we had the assistance of several of our junior colleagues, working in shifts, during the period of roentgenography, and to them all our thanks are tendered.

Diet A. This diet was for twenty-one days the regular Steenbock No. 2965 rachitogenic diet,[7] which in this case had a natural corn oil content of 2.25 per cent and a Ca:P ration of 4.6:1; followed for the next ten days by a fat-free diet which we believed at the time to be rachitogenic, but which subsequently proved unreliable in this respect. It is not recommended.

Casein-Sucrose Fat-free Diet

	per cent
Casein* (extracted with alcohol and ether)	20.0
Sucrose	74.7
Calcium carbonate	1.4
Osborne-Mendel salt mixture [6] ($CaCO_3$ and H_3PO_4 omitted)	3.9
By determination Ca (0.8%): P(0.2%) = 4:1	

*H 1 P from Casein Co. of America.

Diet B. This diet was the regular Steenbock No. 2965 of the same lot as used in A, and was fed for twenty-one days only. When prepared from suitable corn[3] severe rickets is produced in this period of time.

Supplements to these basic diets were added as is set forth below.

Detailed observations have been condensed to what are judged to be significant determinations, characteristic of the main divisions of the work, and are shown in Table 1. The values presented are mean values for each group. They are corrected by omitting such occasional time records as are in excess of five times the calculated probable error. For instance in group 1 A, where 5 rats out of 10 survived the rigorous requirements of the tests and came to the roentgen table, the times recorded for emptying the stomachs are, respectively, 2.5, 2.0, 3.0, 10.0, and 1.5 hours. Obviously the value 10.0 hours represents an abnormality not pertinent to the test, and it was omitted in calculating the mean value 2.3 (omitting the second decimal). Likewise in the same group, the values for the emptying time of the large intestine were as follows: 32, 32, 31, 31 and 48 hours, and the value 48 was eliminated as being out of order.

PART I

The Effect of Vitamin D

Experimental Procedure. Parts I A and I B.

Diet A was supplied to two groups for thirty-one days, during the last ten of

TABLE I

SUMMARY OF SIGNIFICANT ROENTGENOGRAPHIC FINDINGS OF GASTROINTESTINAL MOTILITY IN RATS

Group	Type of Diet		Mean Value Emptying Time in Hours		
			Stomach	Small intestine	Large intestine
IA	Fat-free	Convalescing	2.3	12.2	31.5
IA	Fat-free + vitamin D	Cured	2.2	10.0	18.7
IIA	Fat-free + 5% fat	Convalescing	4.0	8.8	30.6
IIA	Fat-free + 5% fat + vitamin D	Cured	2.0	10.5	20.0
IB	Normal fat	Rachitic	6.7	9.2	16.3
IB	Normal fat + vitamin D	Prevented	2.0	5.2	11.7
IIB	Normal fat + 5% fat	Rachitic	6.0	13.0	26.8
IIB	Normal fat + 5% fat + vitamin D	Prevented	1.8	6.3	11.6

which each rat in one group received daily in one drop of Nujol one unit of Mead's irradiated ergosterol.

Diet B was fed to two groups for twenty-one days, during which time each rat in one group received daily one unit of Mead's irradiated ergosterol dissolved in one drop of Nujol, while the other group was given an equivalent amount of Nujol without antirachitic supplement.

Observations and Discussion.

The rats were rachitic at the end of twenty-one days, but at the end of the thirty-first day showed signs of healing with weight loss, even without vitamin D. The signs of healing are not attributable entirely to the weight loss, in our estimation, and the degree of healing is less in the animals which did not receive the antirachitic supplement than in those which were given the total of 10 rat units of vitamin D in ten days. The observations of this test, together with certain unpublished data, justify the suspicion, at least, that associated with this casein there is a quality which influences the metabolism of a rat in such a fashion that in spite of absence of extractable vitamin D and in spite of a calcium: phosphorus ratio even as high as 8 to 1, it is difficult to prepare a casein diet which is either rachitogenic or of such a nature that it will support the continuance of rickets already established by the No. 2965 diet. We are therefore inclined to regard the "rachitic" group of I A as convalescing from rickets, and will refer to those animals as "convalescing."

With these facts in mind, from the data secured, the following observations appear to be justified:

(a) The average time for the emptying of the stomach of convalescing "rachitic" rats is not significantly different from that for cured animals, 2.3 hours vs. 2.2. hours, and is not greatly different from the time for those animals in which rickets had been prevented, 2.0 hours.

(b) As between definitely rachitic rats and those above described, the time for stomach emptying is distinctly of a different order of magnitude, 6.7 hours. This is in substantial accord with the report of Menville et al.

(c) As between convalescing and cured animals on diet A, the times for complete emptying of the small intestine are not significantly different, 12.2 hours vs. 10.0 hours. As between definitely rachitic animals and those in which (on the same basic diet B) rickets was prevented, there is a distinct difference in favor of the non-

rachitic animals, 9.2 hours vs. 5.2 hours.

(d) The average time period required for emptying the large intestine of the convalescing animals (after fat-free feeding) is distinctly greater than that for the cured animals of the same diet, 31.5 hours vs. 18.7 hours, a difference so great as to elicit question as to its reliability were it not for the fact that the individual determinations for each group do not depart from the mean by more than the probable error for that group in any instance. There is a

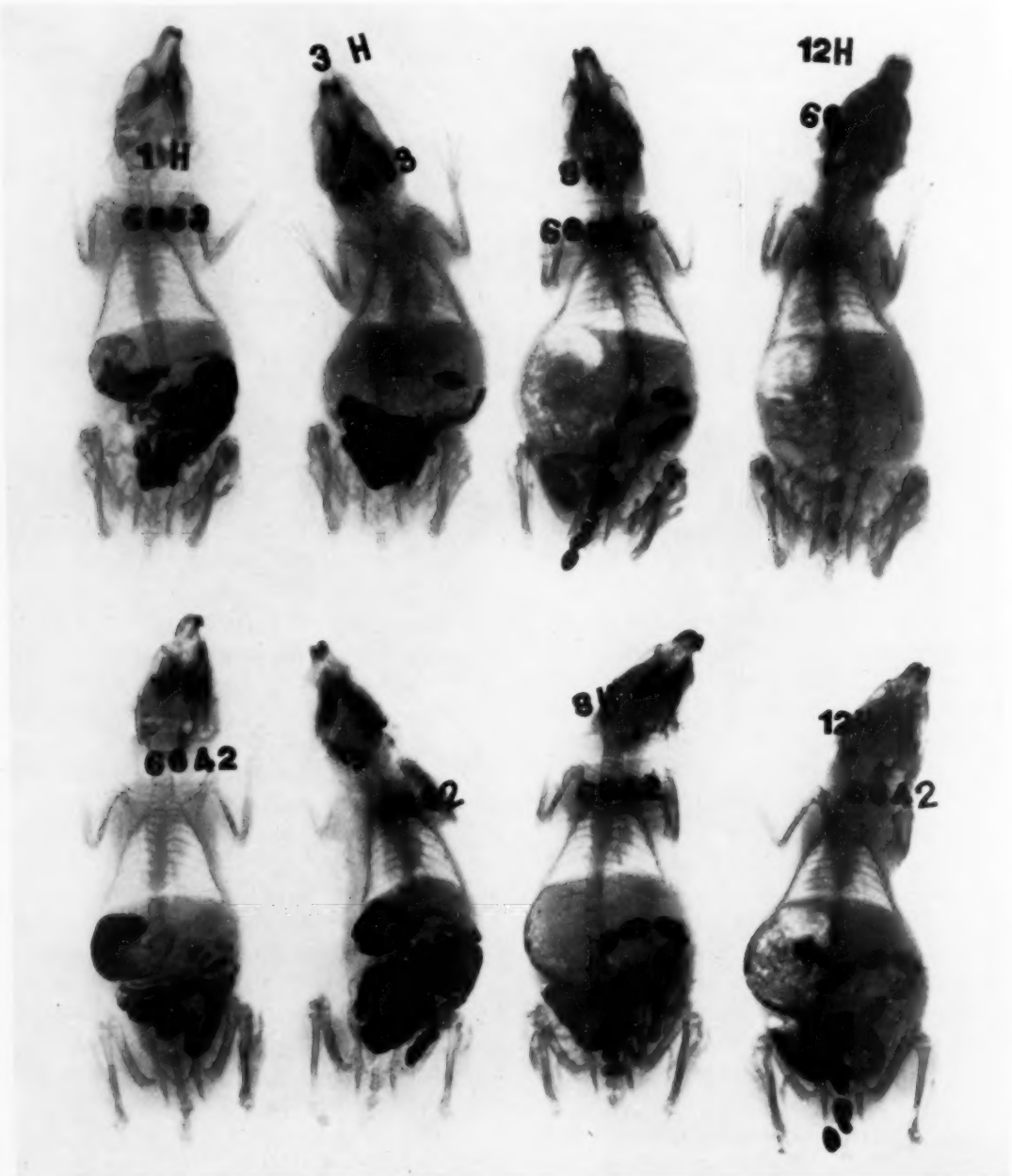

Fig. 1. Progress of a test meal at first, third, eighth and twelfth hour in the digestive tract of albino rats previously fed the rachitogenic diet No. 2965, with and without vitamin D; No. 6653 with added vitamin to prevent rickets; No. 6642 no vitamin, rachitic (cf. Part 1 B).

similar tendency but of a different order of magnitude with the two groups, "rachitic" and "prevented," namely, 16.3 hours vs. 11.7 hours.

Summary of Part I.

It appears that in rickets, metabolic factors other than those diagnosed by bone condition, enter into the effect of rickets upon gastrointestinal motility, but that, in general, the rachitic condition is accompanied by increased hypomotility. This is in agreement with the observed constipation of rickets in rats and in children.

PART II

The Effect of Hydrogenated Fat in the Rachitogenic Diet

Incident to the comparison of rickets and non-rickets of Part I, there are observations which support a preliminary hypothesis that the lipid content of a rachitogenic diet may modify the degree of hypomotility typical of rickets. In Part II there are presented the results of experiments designed to test this hypothesis.

Experimental Procedure. Parts II A and II B.

Diet A was supplied to a group, without curative dose of anitrachitic, over the last ten days and with the addition, during this latter period, of 5 per cent of its weight as edible hydrogenated cotton seed oil (Crisco type of fat).

Diet B was supplied to the appropriate group as in Part I, without antirachitic supplement, and with 5 per cent of its weight as edible hydrogenated cotton seed oil.

Each animal in each group received 1 drop of Nujol per day, corresponding to the vehicle used for administering vitamin D to control groups.

As before, it is assumed that the diet A animals were "convalescing" from rickets, and it is known that the group B animals were definitely rachitic.

Observations and Discussion.

Data derived as already described are included in the tabulation. From these data the following observations are offered:

(a) The time for emptying the stomach of convalescing rats on the fat-free diet A plus 5 per cent hydrogenated fat as compared with that for animals on a similar diet without the added hydrogenated fat is apparently increased (4.0 hours vs. 2.3 hours).

(b) The emptying time of the small intestine of rats on the fat-free diet A plus 5 per cent fat, as compared with that of animals on the same diet without added fat, is shortened (8.8. hours as against 12.2 hours). This finding of hypermotility associated with added fat is the one outstanding apparent inconsistency in the whole series, and we have no explanation to offer.

(c) A similar comparison for the times required to empty the large intestine shows that the addition of 5 per cent hydrogenated fat to the fat-free diet A had no significant effect (30.6 as against 31.5 hours).

(d) The addition of 5 per cent fat to the rachitogenic diet B (with its natural content of 2.25 per cent lipid) had little effect on stomach emptying time (6.0 hours for added fat vs. 6.7 hours for natural lipid).

(e) In the same groups on diet B, the added fat is accompanied by longer time for emptying the small intestine (13.0 hours vs. 9.2 hours).

(f) In the same groups on diet B, the added fat markedly increased the time for emptying the large intestine (26.8 hours for added fat vs. 16.3 hours for natural lipid).

Summary of Part II.

It appears that usually the effect of adding 5 per cent hydrogenated cotton seed oil to a rachitogenic diet is to accentuate the hypomotility of the gastrointestinal tract characteristic of rickets. This is not in accord with expectancy from a comparison of fat-free and normal fat diets, but seems to be a conclusion which is inescapable in view of the recorded findings.

PART III

The Effect of Hydrogenated Fat plus Vitamin D

Part III of the experiment is an artificial subdivision set up for purposes of analysis of the data derived incidental to Part II. It involves the interpretation of the results from the groups which received both added fat and a curative or preventive antirachitic supplement. The following observations are offered:

(a) The addition of 5 per cent hydrogenated fat to a fat-free diet (A) which is supplemented with a curative dose of vitamin D appears to have no effect on the time for emptying the stomach as compared with a similar curative diet without fat (2.0 hours vs. 2.2 hours).

(b) The addition of 5 per cent fat to diet B, supplemented by a preventive dose of vitamin D, seems to have but slight effect on the motility of the stomach (1.8 hours vs. 2.0 hours).

(c) As regards the motility of the small and large intestines when 5 per cent fat is added to diet A with curative antirachitic supplement, the times observed differ less than the probable error of the determinations, and this difference is not significant. The same is true in the case of diet B.

Summary of Part III.

Added hydrogenated cotton seed oil has no significant effect upon gastrointestinal motility in cured or prevented rickets. This is the contrary to the *apparent* laxative effect of the natural corn oil of the Steenbock No. 2965 diet as compared with the casein fat-free ration. This observed effect may very likely be due to some factor other than the natural fat content. At least, no significant effect of lipid content of the diets used in a non-rachitic condition has been proved by these experiments.

CONCLUSIONS

1. A diet lacking vitamin D produces a definite hypomotility of all parts of the gastrointestinal tract of albino rats, as shown by roentgenograms taken during the passage of a barium sulphate-buttermilk test meal. This is in agreement with the constipation which is generally expected in the condition of rickets in rats or human children.

2. The degree of hypomotility in rickets may be modified by the characteristics of the particular rachitogenic diet employed.

3. The gastrointestinal hypomotility of rachitic rats is usually accentuated by the inclusion in the diet of 5 per cent hydrogenated cotton seed oil. In the presence of curative or prophylactic amounts of vitamin D no such effect is observed, the fat in this case having no significant effect.

4. The addition of vitamin D to rachitogenic diets, as a curative or prophylactic measure, markedly alleviates the constipation associated with rickets.

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Vol. 33, No. 1

BENIGN STRICTURE OF THE STOMACH AND ESOPHAGUS*

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MINNEAPOLIS, MINNESOTA

STRICTURE of the stomach following the ingestion of acids or alkalis is a rare condition, and stricture of both stomach and esophagus is very rare. The literature on this subject is meager and few cases have been recorded. Orator[1] states that in Europe acid burns are less frequent than burns from caustics. In this article he reports 4 of his own cases of acid burns involving the stomach, as well as mentioning 34 cases collected from the literature. In 19 of these the stricture occurred at the pylorus, which all authors agree is the most common location for this type of burn. The reason for this preponderance of strictures at the pylorus is thought to be due to spasm of the sphincter produced by irritation of the swallowed acid. Peristalsis carries the acid down to the antrum and keeps pushing it against the contracted sphincter. In this way the acid is held at the pylorus, thus producing the greatest damage there. From the point of view of mortality, Orator finds that this type has the lowest percentage (21 per cent), while mortality in other types ranges as high as 71 per cent.

Vinson and Hartman[2] state that swallowing of lye almost always produces a burn of the esophagus severe enough to produce a cicatricial stricture. In fatal cases, scarring of the mucous membrane of the stomach is sometimes noted, but a stricture the result of a burn at the pylorus is exceedingly rare. However, these authors report such a case in which a lye stricture of both the pylorus and the esophagus occurred, and was proved by post-mortem examination. The 2 cases we are reporting showed similar strictures.

The number of burns from alkalis is much greater, but involvement of the stomach from them is very rare, and pure involvement of the stomach without injury to the esophagus is almost unheard of. In alkali burns, damage to the esophagus predominates, and, as reported by Vinson[3] 102 of 186 cases of cicatricial (benign) stricture of the esophagus were caused by household lye, either in solution or crystals. In acid burns, damage to the stomach predominates and usually affects the pylorus.

The 2 cases that we are reporting show strictures of both the stomach and esophagus due to ingestion of alkalis.

Case 1. A woman, aged forty-two, came to the University Dispensary October 30, 1930, complaining of choking sensations on swallowing. This was located in the lower esophagus and had been present since July, 1930, although she had had slight intermittent choking for many years. When about four years old she drank a solution used for bleaching clothes (probably an alkaline solution) which was the only etiological factor we could find. The general physical examination was negative, and she weighed 185 pounds, which was her normal weight. Laboratory examinations showed hemoglobin 75 per cent, negative blood Wassermann, 19 units of free hydrochloric acid in the gastric contents, and absence of occult blood in the stools.

Roentgen examination at this time showed slight stasis of the barium meal at the distal end of the esophagus, a short distance above the cardia. The appearance was slightly suggestive but not diagnostic of a benign stricture such as occurs following the ingestion of an acid or alkali (Fig. 1). There was marked narrowing of the prepyloric region of the stomach which was smooth in character and very suggestive of a second benign stricture (Fig. 2). Carcinoma of the stomach was considered at this time, but seemed very improbable. The fact that the patient had no symptoms referable to the stomach also tended to exclude gastric malig-

* From the Department of Radiology of the University of Minnesota and the Minnesota General Hospital, Minneapolis, Minn. Presented before the Minnesota Radiological Society, March 10, 1934.

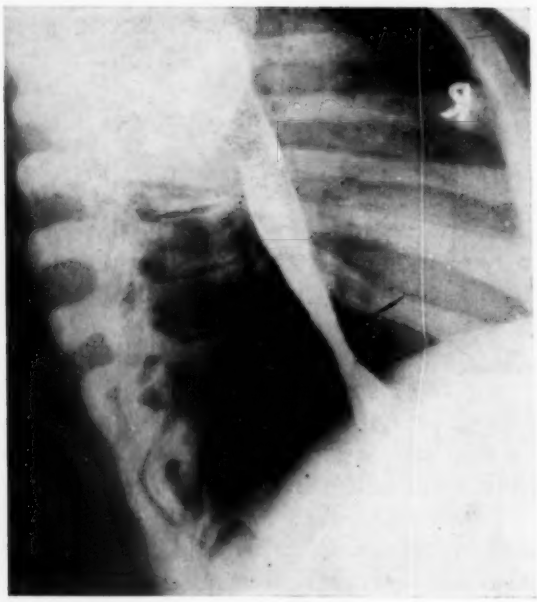

FIG. 1. Case 1. Lateral view of esophagus. Lower part of esophagus (at arrow) shows slight, rather smooth narrowing due to a small benign stricture. Note absence of infiltration, such as occurs with carcinoma. Stricture subsequently dilated with relief of symptoms.

nancy. Subsequent examinations at intervals over a period of three years showed no appreciable change in the stomach and esophagus. The slight persistent delay in the passage of barium through the lower esophagus warranted a definite diagnosis of stricture, which was subsequently proved by the passing of sounds into the esophagus. This slight stricture was successfully dilated by Dr. N. L. Leven with relief of symptoms.

The fact that the patient has been so well for three years, and has no symptoms referable to the stomach, quite definitely rules out gastric malignancy, and indicates that our original diagnosis of benign stricture of the stomach was correct. There are two interesting features of this case: first, the long interval between the alleged swallowing of the caustic solution and the onset of marked symptoms of vomiting following the ingestion of solid food; second, the involvement of both stomach and esophagus, with most marked cicatrization in the stomach.

CASE II. A man, aged fifty-five, came to the University Dispensary June 19, 1933, complaining of pain in the epigastrium and inability to swallow solid food. He stated that four weeks previously he had drunk a pint of moonshine and awoke at four the next morning with pain in the epigastrium, and vomited about a glassful of brownish black fluid. He repeated this several times that day. The next day he began to have difficulty in swallowing solid food, which gradually increased, so that when he presented himself at the dispensary he could swallow only milk. He had lost 20 pounds in weight since the onset and was weak, and had had several tarry stools. He had a constant gnawing pain over the epigastrium, somewhat more marked on the left side, which was still present when he was seen in the dispensary. He obtained slight relief from vomiting, but only very slight relief from milk or alkalis. He saw his local physician who made a diagnosis of carcinoma of the stomach and referred him to the University Dispensary for treatment.

Physical examination was negative except

FIG. 2. Case 1. Posteroanterior view of stomach. Antrum shows marked narrowing extending to base of duodenal bulb. The exact nature of the irregularity within this area could not be determined, but it is, no doubt, associated with the benign stricture. Note smooth character of the stomach adjacent to constricted area and absence of infiltration within it.

for tenderness on pressure in the epigastrium. No masses could be palpated. Laboratory examination showed normal urine, negative blood Wassermann, and normal blood count. A clinical diagnosis of carcinoma of the esophagus or pylorus, and secondly, peptic ulcer, was made.

Roentgen examination of the gastrointestinal tract on June 21, 1933, showed marked delay in the passage of the barium meal through the lower half of the esophagus, with moderate dilatation of the esophagus above this region. This appearance was characteristic of a benign stricture such as occurs following the ingestion of alkalis. It involved a little more than the lower half of the esophagus (Fig. 3). The stomach was markedly dilated and contained a large amount of food and fluid. A very marked benign stricture was present in the antrum over a distance of about 4 cm., and extended slightly into the duodenum. The stomach proximal to the stricture was smooth in character and showed no evidence of involvement (Fig. 4). Only a very small amount of the barium meal passed through the pylorus. Motility study showed almost complete retention. The conclusions from this examination were that a benign stricture was present in both stomach and esophagus. The presence of the esophageal stricture was confirmed by the passage of sounds by Dr. N. L. Leven. It was located 13 inches from the incisor teeth, and was long and diffuse in character. Sounds were passed several times and the stricture dilated to a 31 French, so that the patient was able to swallow some solid food.

Fig. 4. Case 11. Posteroanterior view of stomach. Marked narrowing of antrum of stomach (at arrows) which is smooth in character. Adjacent part of stomach is entirely normal. Stomach proximal to the stricture is markedly dilated. Appearance is characteristic of benign stricture.

Fig. 3. Case 11. Lateral view of esophagus. Marked narrowing of the lower half of the esophagus with moderate dilatation of the upper part is shown. The stricture is very long, but is not complete, and permits the barium meal to pass through slowly. Presence of the stricture was verified by passing of sounds.

The stricture in the stomach, however, progressed so that none of the gastric contents left the stomach. Due to the complete pyloric obstruction a posterior gastroenterostomy was done on July 21, 1933. At operation the walls of the stomach were found to be very thick and edematous, and whitish in color. There was a stricture 4 cm. long in the pyloric region which extended for a short distance into the duodenum. The patient had some vomiting throughout his entire postoperative course. Due to his poor condition he did not withstand the operation well, and expired on August 12, 1933.

Post-mortem examination showed a stricture involving the lower half of the esophagus,

the antrum of the stomach and the first part of the duodenum (Fig. 5). The lumen of the esophagus was patent to about two-thirds of its normal caliber. The stricture in the stomach showed complete closure of the pylorus.

The onset of symptoms soon after the ingestion of the moonshine indicates definitely the etiological agent. No doubt some corrosive material (probably lye) was present in the moonshine. An unusual feature of this case was the presence of a large stricture in both the stomach and duodenum as well as the esophagus.

FIG. 5. Case II. Post-mortem specimen (stomach laid open). Esophagus is only moderately narrowed now, the stricture having been dilated by passing of sounds. Antrum and pylorus show complete closure due to scarring from the alkali. Note the very thick scar tissue which extends for a short distance into the duodenum. The gastroenterostomy, which is patent, is well shown.

In the differential diagnosis of benign stricture of the stomach, gastric malignancy must be considered first. The smooth rounded character of the gastric wall adjacent to the area of stricture and the presence of normal peristaltic waves up to this area would indicate in the 2 cases reported here that these were benign lesions. The absence of an irregular filling defect and infiltration of the adjacent gastric wall would indicate that the appearance was not due to gastric malignancy. The absence of a palpable epigastric mass is also of some help in differentiating these lesions. The presence of a similar stricture in the esophagus in both of these cases would likewise suggest the benign nature of these lesions. The differentiation from chronic prepyloric ulcer can be made by the shortening of the lesser curvature and the displacement of the barium column to this side in this condition. The narrowing, if present, is not nearly as great as that which occurs in strictures due to chemicals. Not infrequently in prepyloric ulcer a niche can be demonstrated which, of course, will help greatly in differentiating these two conditions. In chronic prepyloric ulcer there will also be absence of esophageal involvement. When benign stricture is suspected, the history of having ingested acids or alkalis is of prime importance. However, in our cases the roentgen diagnoses were made before the histories were obtained. Other conditions which might simulate benign stricture are so rare that they scarcely enter into a differential diagnosis.

Benign stricture of the esophagus shows a fairly smooth contour with uniform constriction. The dilatation above the area of the stricture is usually of moderate degree. As a rule, the stricture is not complete, and permits some of the barium meal to enter the stomach. In carcinoma of the esophagus a fairly large irregular filling defect is present, and considerable dilatation of the esophagus above the infiltration occurs. The malignant lesion is not as extensive as the benign stricture. Here again the patient's history is of great importance. The presence of a second stricture in the stomach helps to confirm the diagnosis.

Stricture of the esophagus must also be differentiated from cardiospasm. In the latter condition the constriction always occurs at the distal end of the esophagus and extends over only a very short distance. Stricture, on the other hand, may occur in any part of the esophagus, and is usually quite extensive. The contours of the esophagus adjacent to the spastic area are smooth in character and taper gradually to the area of spasm in contrast to a stricture in which the contours are irregular and lack the gradual tapering down to the area of constriction. During the period of spasm in cardiospasm none of the barium meal enters the stomach, whereas a continuous trickle into the stomach is usually present in stricture. The dilatation of the esophagus may become enormous in cardiospasm while it is usually only moderate in stricture.

The following roentgen findings suggest benign stricture of the stomach: first, a fairly uniform narrowing, most commonly in the antrum of the stomach, and, second, a smooth gastric contour adjacent to the area of constriction, with normal peristalsis in it. The stomach is usually dilated, sometimes to a marked degree as in our second case. The presence of a concomitant stricture in the esophagus will help to clinch the diagnosis.

While benign stricture of the stomach and esophagus is a relatively rare condition, it should be thought of when esophageal and gastric lesions do not show findings characteristic of other diseases. A concomitant lesion in esophagus and stomach is very suggestive of benign stricture. A history of swallowing of corrosive material is, of course, of prime importance in establishing the diagnosis. The findings enumerated above will help in the diagnosis and differentiation of this condition from other esophageal and gastric lesions.

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CONGENITAL DIAPHRAGMATIC HERNIA

CASE REPORT

By J. FRIEDMAN, M.D.
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BABY P., female, delivered by forceps at full-term weighing 6 lb. 6 oz., was breast-fed and took its feedings well until the eighth day. It never vomited, bowel movements were normal, of good color and consistency. No cyanotic spells were noticed at any time. It was an unusually quiet child. It was observed that the abdomen in the baby was flat and remained so even after feeding. On the ninth day, one day after its discharge, it developed rapid breathing and became slightly cyanosed.

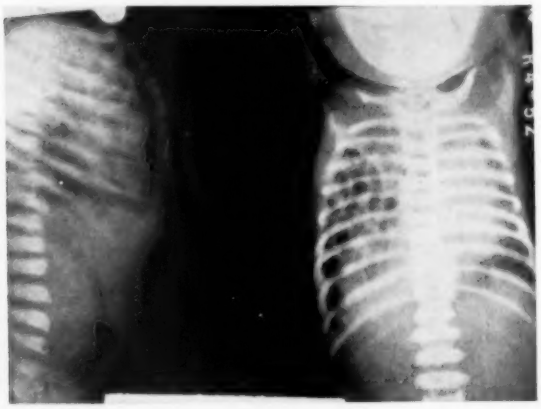

FIG. 1

The roentgen examination (Fig. 1), taken in recumbent position, showed then a honeycomb network occupying the entire left chest. The heart and trachea were displaced to the right, and an over-aerated right lung was seen along the right thoracic border and at the right base. The right diaphragmatic dome was well visualized; the left one was not clearly outlined. A large dense homogeneous shadow occupied the abdomen. The stomach and intestines were not visualized; one moderately distended bowel loop was noticed running along the left abdominal border and disappearing through the posterior portion of the left diaphragm into the left chest. A diagnosis of diaphragmatic hernia and thoracic stomach and intestines was made.

The baby was immediately admitted to this hospital and died three hours later.

Post mortem a rectal tube was introduced 21 cm. high as a barium enema was attempted, but the barium was returned. A tube was introduced into the stomach and barium injected. Figure 2*a* was taken in recumbent position; Figure 2*b* upright anteroposteriorly, and Figure 2*c* upright laterally. They show the rectal tube arrested in the left lower abdomen forming a coil there. The esophagus is short and located to the right side of the spine. The stomach is located above the diaphragm in front of the lower dorsal spine, of vertical position. The greater curvature of the stomach points to the right and upward. The pylorus points downward and is located above the esophageal opening of the diaphragm immediately to the left of the midline. The duodenal bulb, distinctly visualized, is situated at about the normal esophageal opening of the diaphragm. The rest of the left pleural cavity is occupied by intestinal loops.

The heart is located in the right chest, and the lateral and lower portion of the over-aerated right lung is seen only.

Synopsis of Autopsy Report (eighteen hours after death). The subject was a large, well-nourished, female infant from the pediatric service (Dr. Scherzer). On external examination the thorax was large and symmetrically rounded. The abdomen was also symmetrical but unusually flat; it failed to yield a tympanitic note on percussion.

Upon examination of the viscera the left thoracic cavity (Fig. 3) was found to contain the bulk of the abdominal organs. This displacement was possible because of a large defect in the left diaphragm, the details of which will be treated subsequently. On opening the thorax there presented coils of small and large intestines, lying under which were the stomach and other organs. The stomach was fixed at the cardiac ring by a normal esophageal opening in the diaphragm, the distal portion being rotated upwards and to the left through the diaphragmatic opening so that the pyloric ring was lying at the level of the third rib posteriorly. The duodenum, pancreas, and spleen,

with their attached peritoneal folds, were also lying within the pleural cavity. The displacement of these organs was possible due to stretching and lengthening of the structures of the portal space and vessels of the celiac axis. The liver was in the abdominal cavity but was displaced downward by the very low right diaphragm. The large intestine was of normal length and had a persistent mesentery 8 to 10 cm. in length which was continuous above with the mesentery of the small bowel at the ileocecal valve and ended below at the pelvic brim. This persistent mesentery permitted the unusual mobility of that portion of the large intestine proximal to the splenic flexure, and its displacement upward into the left thoracic cavity.

Fig. 2c

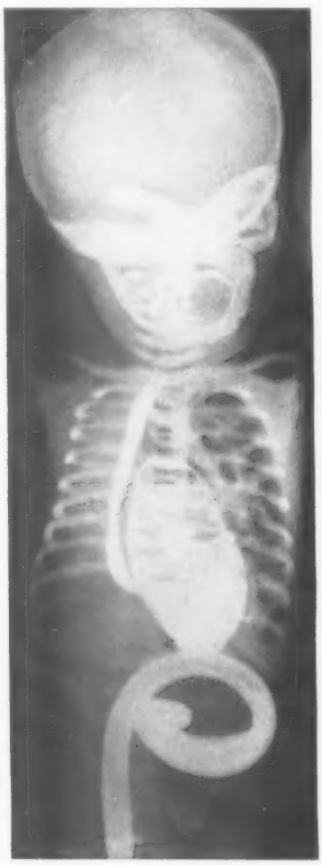

Fig. 2b

Fig. 2a

As stated previously, the extensive herniation of the abdominal viscera was permitted by a congenital defect in the posterior lateral portion of the left diaphragm; this formed a large round opening, 4 cm. in diameter. The medial portion of the diaphragm, including the left crus, central tendon and middle leaflet, were well developed, but these structures became gradually thinned to form the smooth and pale gray medial and anterior margins of the defect, while the thoracic cage formed the lateral and posterior margins. The peritoneum apparently ended at the margins of the defect so that no sac covered the displaced abdominal organs. The medial half of the opening contained the cardiac ring of the stomach, portal structures, mesentery and large intestines, while coils of small intestine passed readily through the lateral half. There was no evidence of obstruction in any part of the gastrointestinal tract.

Occupation of the left pleural cavity by the abdominal organs resulted in marked displacement to the right of the thoracic viscera. The left lung was completely collapsed and it lay about its hilus as a uniformly small pale red, fleshy, airless mass. As measured at the level of the bifurcation of the trachea, the ex-

tent of displacement to the right of both the trachea and esophagus was 1.5 cm. The pericardium and heart were also much displaced, the apex of the heart lying 1 cm. to the left

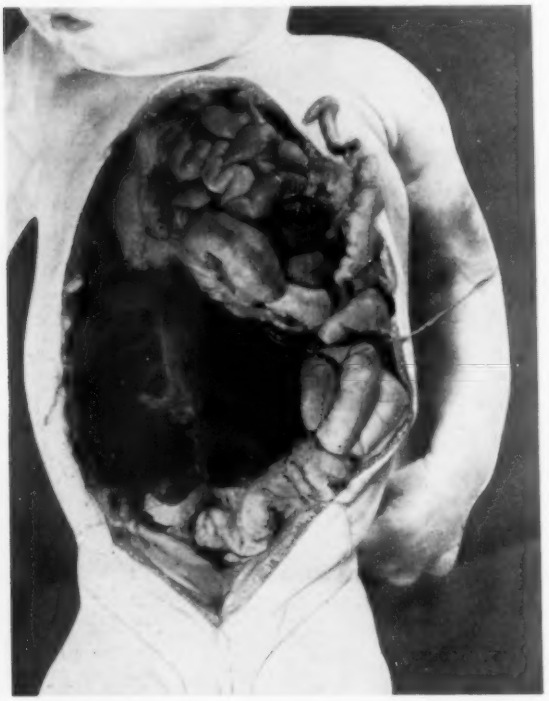

FIG. 3

of the midline, and the margin of the dilated right side 3.2 cm. to the right. Subsequent examination of this organ showed the foramen ovale and ductus arteriosus to be patent, but failed to disclose any defect in the valves or great vessels. The right lung was very distended and emphysematous. It completely filled its pleural cavity and displaced the dome of the diaphragm downward to the level of the lower costal margin.

The only other congenital anomaly was an incomplete reduplication of the right ureter; these became joined at a point 8 cm. below the pelvis. As is usual, the lower pelvis drained the middle and lower kidney segments, while the upper drained the remaining upper third of the kidney.

Anatomical Diagnosis. Spurious left diaphragmatic hernia with (*a*) ectopia of the stomach, large and small intestines with their attached peritoneal folds, spleen and pancreas; (*b*) displacement to right of the medial thoracic structures; (*c*) pressure collapse left lung and compensatory emphysema right. Persistent mesentery large intestine. Incomplete right double ureter.

Comment. The autopsy corroborated the roentgen findings, except that no cause was found for the obstruction of barium in the lower colon on injection about three hours after death. It must be suggested that this obstruction to the passage of barium may have been due to a rigor mortis constriction which could not be demonstrated at autopsy about fifteen hours later.

SUMMARY

A case of congenital diaphragmatic hernia is reported, which was diagnosed roentgenologically during life and confirmed by autopsy.

I wish to thank Dr. W. H. Chase, pathologist, Woman's General Hospital, for his most thorough and interesting pathological study of this rare anomaly.

Vol. 33, No. 1

FRACTURE OF THE ANTERIOR SUPERIOR SPINE OF THE ILIUM IN ONE CASE, AND ANTERIOR INFERIOR IN ANOTHER CASE

By IMRE WEITZNER, M.D.
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CHRISTOPHER[1] collected 44 cases of fractures of the anterior superior spine of the ilium, published up to 1924, and added one of his own, making 45. Consequently the one here reported is the forty-sixth.

All cases reported are, naturally, only indirectly traumatic. Fractures by direct violence do not belong to this group.

The spina iliaca anterior superior is the place of insertion for the ligamentum inguinale, tensor fasciae latae and the sartorius. The probable cause of the fracture is an over-flexion of the thigh and an over-extension of the leg in a very sudden motion. This occurs mostly in runners and football players. The age of the patients is the so-called "epiphyseal age." Waldeyer mentions that the anterior superior spine develops from an independent osseous center, which arises in the fifteenth to sixteenth year and unites with the ilium in the sixteenth to seventeenth year.

The fracture of the spina iliaca anterior inferior was quoted by Köhler[2] as the only one reported in the literature. My case accordingly appears to be the second.

The anterior inferior spine is the place of insertion for the rectus femoris only. Its physiological function is the same as that of the sartorius, namely, flexion of the thigh and extension of the leg. For this reason fractures occur under similar circumstances at these spinous processes.

REPORT OF CASES

CASE I. Boy, white, aged seventeen, tall, muscular, football player on his high-school team. In the fall of 1930, during a game he kicked a ball with great force. Immediately afterwards he felt a sudden pain in his right loin region. He was forced to leave the field, and walked without assistance, but with a limp, to his dressing room. Believing that he had sprained his leg, he applied home medication, i.e., rest, massage, bath. After seven days he was forced to visit the family physician, who referred him to me for roentgen examination which disclosed a fracture-separation of the anterior superior spine of the left iliac bone, with a slight inferior displacement (Fig. 1). After four weeks' rest and conservative treatment he returned to his team without any complaint. He did not return for another roentgen examination, so I cannot report on the method of healing.

FIG. 1. Case I. Boy, aged seventeen. Fracture-separation of the left anterior superior spine of the ilium. This roentgenogram was taken seven days after the accident.

CASE II. Male, white, aged thirty-two, well built, healthy, professional football player for the last fifteen years. During a game in 1932 he kicked a standing ball, with all his ability and strength. Immediately he felt a terrific cramp-like pain in his right loin region. He was helped out of the field and after a rest of two hours he was able to walk with difficulty and

[1] Christopher, F. Fracture of the anterior superior spine of the ilium. *J. Am. M. Ass.*, 1933, *100*, 113–114.

[2] Köhler, Alban. Röntgenology: The Borderlands of the Normal and early Pathological in the Skiagram. Translated from the Fifth German Edition by Arthur Turnbull. William Wood & Co., New York, 1928.

FIG. 2. Case 11. Male, aged thirty-two; football player. Fracture of the right anterior inferior spine of the ilium. This roentgenogram was taken three days after the accident. The broken off bone is still in connection with the ilium.

limp without assistance. Three days after this accident he was referred to me for examination, which disclosed a fracture of the inferior anterior spine of the right ilium (Fig. 2). A small triangular fragment of bone was broken off and it was displaced inferiorly in such a manner that its base was still firmly connected with the ilium. It gave the impression of an "open envelope," i.e. it was torn downwards by force, leaving its base connected with the iliac bone. After four weeks' rest, the patient walked without limp, but he was not able to kick the ball well. After four months he felt well and returned to play, emphasizing the fact that he could flex his thigh higher than before and he is able to kick the ball better than ever. For his statement, I found an explanation in the second roentgenogram (Fig. 3). This shows the broken down inferior process in the same position as before, without atrophy, which indicates that it found a permanent place in its downward position, giving to the rectus femoris a more inferior position which consequently permits a better flexion of the thigh.

COMMENTS

The sartorius, which is more superficial than the rectus femoris, goes into action earlier and carries more weight, consequently its place of insertion, the spina iliaca anterior superior, fractures more easily than the place of insertion of the rectus femoris, the inferior spine. The ossification of the superior spine is not quite completed when young men are most vigorously engaged in active sports, while the inferior spine is ossified at that age. In addition, greater exertion is required by the deep-seated rectus femoris to cause a fracture. This is the explanation of why young men fracture the superior spine and older ones the inferior. Men at older age are not active as a rule in the vigorous sports, unless they are professional. This also explains why 46 cases are reported of fracture of the superior spine and only one of the inferior spine.

I believe that these fractures are more common than is reported. Due to the fact that their symptoms are relatively slight they do not come under medical care. In case they do, their cause is not recognized.

FIG. 3. Case 11. Four months later, the broken off anterior inferior spine is almost in the same position as immediately after the accident. Atrophy of disuse did not occur, indicating that the process is permanent in its position.

Vol. 33, No. 1

TECHNIQUE AND RESULTS OF IRRADIATION IN CARCINOMA OF THE BREAST*

A REVIEW OF 1,129 PRIVATE CASES

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and
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PHILADELPHIA, PENNSYLVANIA

THERE is probably no member of this Congress who will dispute the value of irradiation in the treatment of carcinoma of the breast. All of you have surely seen primary advanced carcinomas improve, shrink in size, ulcerations heal, and sometimes disappear. You have all seen recurrences disappear under irradiation, and metastatic lesions involving bones, even when associated with fractures, have healed, and life has been prolonged. You have also been convinced that irradiation added to operation improves the results as compared with operation alone. We are convinced that carcinoma can be made to disappear if sufficient radiation from roentgen rays or radium can be brought to bear on all of the diseased cells. In previous papers, we have analyzed over 1,000 cases of carcinoma of the breast, with regard to age, sex, frequency of recurrences, delays in beginning treatment after recurrences, and the leading symptoms which have first attracted the patient's attention, together with a demonstration of the good results obtained in postoperative, recurrent, and primary advanced carcinoma. For the sake of brevity, therefore, in this presentation, which involves a review of 1,129 cases, we will confine our discussion to the studies in technique and the results that have been obtained on cases treated more than three years ago. We will not discuss the diagnosis nor the indications, both of which, however, are very important.

One of us (Pfahler) began the treatment of carcinoma of the breast by treating, in 1902, a case with recurrence located in the operative scar resulting in cure. At that time unfiltered radiation in fractional doses, frequently repeated, with very crude methods of measuring dosage was in use. In 1905, one of us (Pfahler)[5] was probably the first to use filtration to eliminate the softer rays which would ordinarily be absorbed by the skin, which permitted a relatively greater depth value. At that time, this filter consisted of sole leather, which based upon Walter's physical measurements upon metals, led Pfahler to assume that skin and superficial soft tissues absorb a particular kind of radiation. Later, this filter was replaced by 1 mm. of aluminum, and finally by 6 mm. of aluminum, or its equivalent, as a routine procedure. During the period from approximately 1910 to 1922, the treatment of these cases was carried on with approximately 135 kv., 5 ma., 6 mm. of aluminum filtration, or a combination of copper and aluminum equivalent to 6 mm. of aluminum, and at a distance varying between 25 and 40 cm., the time being governed by the dosage desired, and the distance of the skin from the target of the tube. Since 1922, and to the present date, we have been using a combination of high voltage roentgen rays in conjunction with the above described low voltage technique and more recently combined with radium. The details of this technique will be described in more detail.

GENERAL TECHNIQUE 1922 TO 1933

At no time during the past nor up to the present have we been able to establish a definite technique or plan of treatment that can be recommended for all patients. It has been our aim to individualize the

* Read before the American Congress of Radiology, Chicago, Ill., Sept. 25–30, 1933.

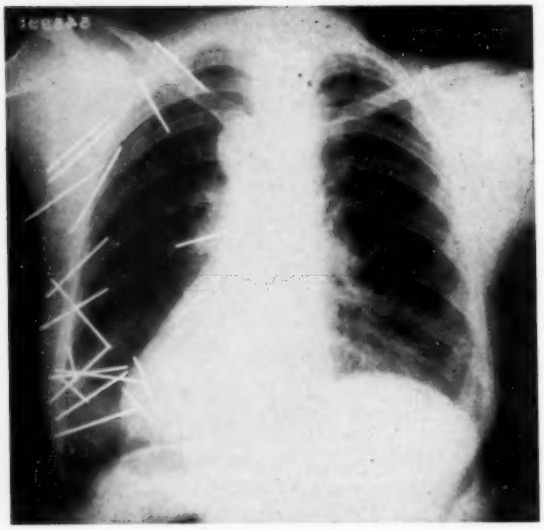

FIG. 1. Shows the distribution of 6 cm. and 4 cm. irridio-platinum needles, with 0.6 mm. wall thickness, each containing 2 mg. of radium.

treatment, and to outline a technique that will accomplish the best results in each particular case, for there are scarcely two cases alike. As we have often repeated, one cannot standardize the roentgen treatment of cancer until cancer grows according to standard. One can only lay down principles or describe a general outline, or a general plan of action, which must be modified according to existing conditions. The technique will vary in treating a primary carcinoma of the breast, a recurrence, or an advanced metastatic disease, and it must be varied according to the stage, extent and type of the disease. The first essential, therefore, in planning any technique is to estimate as nearly as possible the extent, the type, the age, the duration, and the location of the most distant part of the disease, for unless one goes well beyond the most distant recognized disease, failure will result. Therefore, the more the radiologist knows about carcinoma of the breast, its methods of extension, and its likely distribution in the individual case, the better will be his position in outlining the treatment, and in modifying this treatment according to developments.

It is well known that metastases take place more quickly and more widely in fat women than in lean women. Therefore, when dealing with carcinoma in a fat person, the irradiation must be distributed more widely than under opposite conditions, and the total irradiation in any field will be limited, for fat does not stand a total of more than 200 to 400 per cent of an erythema dose. This requires more fields to get sufficient cross-fire effect on the disease. Likewise, the cross-fire problem differs when dealing with a fat person as compared with the thin person. Furthermore, in planning the treatment, the distribution or direction of the irradiation must be chosen and planned so as to protect as much as possible the essential organs, especially the heart, great vessels and the lungs.

One of our great problems, therefore, is to irradiate the mammary region, the mediastinum, and the roots of the lungs without damage to the heart, the blood stream, and lung tissue. For the protection of the heart and the lungs, therefore, it is our custom to irradiate the tissues on the outside, and including the chest wall, by means of tangential irradiation as much as is possible as has also been urged by Holfelder, and Hintze.[2] We carry out the

FIG. 2. Shows the radiation effect as shown in the photographic film, as indicated by the fog in three minutes. These needles continue their action which reaches the entire lymphatic area, including the mediastinum, during a period of five days.

principles of the saturation technique as previously described,[6,7,8,9,10] in all cases.

PRIMARY CARCINOMA OR PREOPERATIVE TREATMENT

For the above reason, it is our custom when dealing with a primary carcinoma to direct high voltage roentgen rays outward through the breast tissue and the chest wall, through a field which begins with the parasternal line and extends to the nipple line, and from the lower border of the mammary region to a line drawn from the first costal cartilage to the upper portion of the anterior axillary fold. A second field of irradiation is taken from the median axillary line inward to the nipple line, and to the sterno-axillary line and the lower border of the mammary region, as mentioned before, using high voltage roentgen rays, and so arranging that the posterior level of the beam will simply skim the inner surface of the anterior wall of the chest. A third field for high voltage irradiation is then chosen and directed through the axilla above the previous two fields toward the coracoid and deep cervical region, and toward the upper mediastinum. A fourth field of irradiation is used with high voltage roentgen rays extending from the sterno-axillary line to the posterior border of the supraclavicular space, directed anteroposteriorly and slightly downward. In treating the anterior mediastinum, in order to avoid undue effect on the heart, we then use low voltage roentgen rays, such as is described above, extending from the episternal notch down to the epigastrium. This gives the greatest conservation of the normal tissue with the greatest effect on the lymphatics, and the likely lines of extension, therefore, doing the greatest good and the least damage. If conditions will permit or if there is already suspicion of involvement of the spine or posterior mediastinum, it is advisable to utilize a sixth field extending from the inner border of the scapula to the opposite paravertebral line and from the cervical to the twelfth dorsal vertebra. The earlier the diagnosis and the earlier the treatment is given, the less extensive and the less expensive will be the treatment.

Fig. 3. Shows the distribution of radium needles in an extensive inoperable axillary recurrence. This patient recovered from the local recurrence but six months later died of some pulmonary condition.

In the arrangement of the treatment of these fields, the most accurate set-up is necessary, and it has been our custom to do this ourselves instead of trusting it to technicians. Certainly, the final supervision of each set-up should be reviewed by the radiologist, unless one is willing to sacrifice accuracy and results. We are quite sure that some of the unsatisfactory results are due to carelessness or inaccuracy in details of planning and carrying out the technique properly.

The above plans are those that are useful particularly in preoperative roentgen treatment. It is our aim in this preoperative treatment to give at least 700 to 800 r, usually divided into two doses, through each field in the group of cases in which axillary involvement is present, or is suspected. Such preliminary treatment usually requires about two weeks. We have not found that it interferes with operation. If, for any reason, the patient cannot or will not be operated upon, then further plans should be made for the interstitial use of radium according to the Keynes technique, followed by additional roentgen treatment.

In carrying out the Keynes technique,[3] the main principle is to obtain a continuous

irradiation evenly distributed throughout the diseased area, and so far as possible, along the line of the most common lymphatic extensions. This requires a considerable amount of radium, usually from 75 to 100 mg., distributed in groups of needles varying in content from 1 to 3 mg. each contained in irridio-platinum needles, varying from 3.2 to 4.8 cm. in length, and with the walls 0.5 mm. in thickness. We have been using needles 2.7 cm. in length and 0.5 mm. in thickness of irridio-platinum, and each containing 1 mg. of radium, and a series 4 cm. in length, 0.6 mm. in wall thickness of irridio-platinum, and each containing 2 mg. of radium. The most useful are 6 cm. in length, 0.6 mm. in thickness and each containing 3 mg. of radium. They are allowed to remain in the tissues from five to eight days, according to the amount of high voltage roentgen rays that is added.

It is the aim to introduce these radium needles surrounding the tumor areas and particularly the pectoral fascia, located underneath the tumor. At times, this will require irradiation also in several layers involving the tumor tissue, but when it is avoidable it is the aim not to introduce the needles directly through the tumor tissue. The needles must be distributed also in the walls of the axilla, avoiding any puncture of the vessels or nerves. Keynes says, "Among the 171 patients, I have treated, no one has suffered an injury to a vessel or a nerve in the axilla." It is also advisable to distribute needles above the clavicle and below the clavicle. These must ordinarily be of the shorter length variety. Keynes leaves these needles in place usually a week, and after one to four months if the disease has not disappeared, a repetition of the treatment may be given. Lee and Pack[4] found no evidence of spreading of the disease as a result of their interstitial irradiation. Preliminary external irradiation lessens the danger of dissemination.

We have modified this procedure somewhat by combining high voltage roentgen therapy before and after so as to get a wider distribution of the radiation effect, and to utilize the needles for a more intensive local effect, where there is palpable disease. On this account, and in order to obtain a more even irradiation effect, we usually allow the needles to remain in place only five days, and then supplement with sufficient high voltage roentgen rays to irradiate the entire outlying lymphatic areas, including, of course, the palpable tumor tissue in the breast.

With the object of making the radium needle punctures more safe, it has been our custom to give the same amount of high voltage roentgen treatment that is given in the preoperative cases, and then if it seems better to operate, we have the patient operated upon. If it seems better to treat the patient by radium needles at that same stage, we then introduce the radium needles, and whether the patient is operated upon or has the radium needle treatment, we follow with more high voltage roentgen treatment. In all this treatment, it is our aim to keep the tissue saturated to the limit of normal tissue tolerance during a period of three or four weeks. This "saturation technique" has given us our best results.

In the more advanced cases in which there are supraclavicular lymph nodes, we advise that the patient be given at least three times this amount of treatment, and that the operation, if decided upon, should be postponed generally from two to three months, so that the outlying lymphatics can have an opportunity to be sealed off by fibrous tissue, which will probably then permit a local mastectomy. Again we repeat that no rules can be laid down but that each case must be judged according to the conditions present.

POSTOPERATIVE IRRADIATION IN CARCINOMA OF THE BREAST

In general, the above plan of treatment is carried out except that the mammary region, as well as the anterior mediastinal region, is treated with low voltage roentgen rays because it is then necessary to send the rays directly into the chest wall, and

at least as much postoperative irradiation should be given as preoperative irradiation. We aim to give approximately a total of 1,750 to 2,100 r through each field, which should include both the preoperative and postoperative irradiation. If there is no preoperative irradiation, then more postoperative irradiation is necessary. Following this treatment the patient is kept under observation and more treatment is added if doubts arise.

RECURRENT CARCINOMA OF THE BREAST

This group especially needs individual plans. At times, where there are localized small nodules in the operative field, they may be destroyed by electrothermic desiccation, or 3 skin erythema doses can be given over each nodule, with 125 kv., 2 mm. Al. If the disease is of the indurated type developing along the line of the scar, local surface applications of radium will probably be of most use. If, however, the disease recurs in the coracoid and axillary region, probably irradiation with 2 mm. copper filtration, high voltage technique, will accomplish the best results. At times, we have obtained help by the interstitial introduction of highly filtered, low-content radium needles, or we have used radium capsules, properly timed, spaced and screened. In all these advanced cases, one must continually re-examine the chest, the mediastinum, and the bones for metastasis, and irradiate any suspicious areas.

RESULTS OF RADIATION TREATMENT IN CARCINOMA OF THE BREAST

Primary Carcinoma. It is still too early to draw conclusions as to results from the use of the Keynes technique. There have been an insufficient number of cases treated and the time of observation is too short. Keynes has reported on 171 cases and states, "In general, the results of radium treatment compare favorably with those obtained by any other method of treatment, such as pure surgery. In the most

The following is an analysis made by Dr. Forber of the 131 cases of breast cancer treated by Keynes.[3] (Class I. Operable; no glands palpable. Class II. Operable; glands palpable. Class III. Inoperable.)

	Total Cases	Alive at 3 years	Died of Cancer	Died of Intercurrent Disease	Percentage Alive at 3 years
Patients treated three or more years ago.					
Class I	9	7	2	0	77.7
Class II	11	4	5	2	36.3
Class III	26	12	13	1	46.1
Patients treated over two and under three years ago.					
Class I	16	13	3	0	81.25
Class II	16	11	5	0	68.75
Class III	5	0	5	0	0.0
Patients treated over one year and under two years ago.					
Class I	22	20	2	0	90.9
Class II	16	10	5	1	62.5
Class III	10	5	5	0	50.0

Note.—Of those patients at three years, 3 in Class I, 1 in Class II, and 4 in Class III had either died of cancer or were dying at the time of writing. One of these in Class I died of a malignant ovarian tumour. Accepting the results published by the Ministry of Health the percentage of those treated by surgery alone and alive at three years in Class I was between 75 and 78, and in Class II between 41 and 44.

successful cases, the patients are virtually normal women, and their expectation of life is at least as great as if they had been subjected to a mutilating operation," and he states further, "No exaggerated claim is made for radium treatment as that it should be used to supplant surgery. It is claimed that radium ought to have a definite place in the treatment of carcinoma of the breast, and should often be used instead of, or combined with, surgery according to the individual circumstances."

Insufficient time has elapsed for us to definitely evaluate this method of treatment by statistical analysis of *our own cases*. We have treated 22 cases of carcinoma of the breast by the modified Keynes method, of which 19 were primary carcinomas. *Of these, 13, or 59 per cent, were alive and free from palpable evidence of disease for a period of from fourteen to twenty-seven months;* 2 were alive for twelve and fifteen months respectively, but were not free from the disease, 3 patients had died from the disease, and 1 patient from intercurrent disease three months after treatment was instituted.

There were 3 cases of postoperative recurrence treated by this method, all of which died, six, seven and fourteen months respectively after treatment was instituted.

From a study made on 109 primary operable cases of mammary carcinoma on whom complete data for a period of no less than five years are available, Adair[1] draws the following conclusions: "Irradiation, if properly applied can be relied on to effect a cure in cases of mammary cancer in 36.3 per cent. It offers a substitute weapon, but slightly less effective in five year results than the combination of radium and surgery (40.6). In cases where surgery is contraindicated, combined interstitial and external irradiation is our most efficient agent."

We have treated 254 cases of primary carcinoma in which irradiation, chiefly roentgen therapy, alone was used, as is indicated by Table I.

These cases did not have biopsies, and therefore no microscopical examination. However, in the inoperable group, there is ordinarily little doubt about the diagnosis. We are fearful of traumatism incident to doing a biopsy. Keynes did biopsies in the first 50 cases, and he was then convinced that he was doing more harm than good, after which he discontinued biopsies.

Of the 195 cases classed as inoperable, 76, or 39 per cent, were living at the end of three years, but of these 76, 11 still had disease present. Of the 119 known to be dead or lost from record, 6 died from intercurrent disease.

Of the 181 cases that were treated more than five years ago, 43, or 24 per cent, were alive, but 4 of these still had disease present, and of the 138 considered dead, 8 died from intercurrent disease, and 6 could not be traced.

There were 124 inoperable cases treated more than ten years ago, and of these 25 were still alive, and there was no palpable disease. Of the 99 of this group that were considered dead, 11 died of intercurrent disease and 2 could not be traced.

TABLE I

PRIMARY CARCINOMA—254 CASES—TREATED BY IRRADIATION ONLY

	Alive over 3 years	Alive over 5 years	Alive over 10 years	Alive over 15 years
Inoperable	39% of 195 cases	24% of 181 cases	20% of 124 cases	15% of 67 cases
Operable definitely malignant	88% of 44 cases	87% of 40 cases	49% of 39 cases	48% of 29 cases
Doubtfully malignant	87% of 15 cases	91% of 11 cases	82% of 11 cases	75% of 8 cases
Total	88% of 59 cases	88% of 51 cases	51% of 50 cases	54% of 37 cases

Of the operable group, there were 44 cases in which there seemed to be no doubt clinically as to the diagnosis.

Recurrent Carcinoma. In the recurrent carcinoma, there can be little argument as to diagnosis, and we are definitely convinced that irradiation is the best form of treatment. Of this group, we have had 476 cases. Thirty-one per cent were free from disease at the end of three years; 21 per cent of 453 cases were symptom-free at the end of five years. Of 388 cases which were treated more than ten years ago, 8 per cent were symptom-free. Of the recurrent cases which were treated more than five years ago, 61 cases had local recurrences and of these, 48 per cent have remained well; 73 cases had axillary and supraclavicular nodes, and of these, 22 per cent have remained well. Of 319 cases with distant metastases, 16 per cent were alive after five years.

Of the 319 patients regarded as dead in three years, 21 could not be traced and 14 died of intercurrent disease. Of the 127 alive, there was disease present in 33.

Of the 358 patients regarded as dead in five years, 25 could not be traced, and 16 died of intercurrent disease. Of the 95 alive there was disease present in 13.

Of the 357 patients regarded as dead in ten years, 31 could not be traced, and 19 died of intercurrent disease. Of the 31 alive, there was disease present in 1.

Of the 192 dead in fifteen years, 19 could not be traced and 9 died of intercurrent disease. Of the 29 alive, there was disease present in 1.

There is only a slight difference in prognosis, duration of life, following irradiation in relation to the time of recurrence after operation.

The patients in whom there is a recurrence within two and four months after operation appear to have a slightly greater life expectancy than those recurring later, when treated by irradiation, probably because the disease is more radiosensitive. There is a rather high percentage of patients alive three years after beginning irradiation in that group in which recurrence did not appear until sixty or more months after operation. This can probably be explained by the low degree of malignancy of those tumors with late recurrences.

Patients treated within one and two months after the recurrence is discovered have a longer duration of life and there is a greater percentage alive in three and five

Table II

RECURRENT CARCINOMA—476 CASES

	Alive over 3 years	Alive over 5 years	Alive over 10 years	Alive over 15 years
Local recurrence	54% of 65 cases	48% of 61 cases	30% of 60 cases	29% of 42 cases
Axillary and supraclavicular glands	36% of 78 cases	22% of 73 cases	10% of 59 cases	9% of 45 cases
Distant metastases	25% of 333 cases	16% of 319 cases	7% of 269 cases	9% of 134 cases
Total	31% of 476 cases	21% of 453 cases	8% of 388 cases	13% of 221 cases

Table III

RELATION OF TIME OF RECURRENCE AFTER OPERATION AND DURATION OF LIFE FROM BEGINNING OF IRRADIATION

	Time of Recurrence after Operation in Months								
Months	2	4	6	9	12	18	24	36	60
No. of cases	99	45	42	33	28	32	26	35	56
Average duration of life in months	46.9	54.3	24.5	30.9	34.1	32.7	28.1	25.7	40.1
Percentage of patients alive in 3 years	36	26	17	21	28	31	23	20	42
Percentage of patients alive 5 years	24	22	7	12	11	21	19	10	16

years after beginning treatment than in those in which the recurrence has been present a longer time.

POSTOPERATIVE TREATMENT OF CARCINOMA OF THE BREAST

It is this group of cases, and especially the group of cases in which there are palpable lymph nodes in the axilla, in which postoperative irradiation has shown its greatest beneficial effects. It is well known that when primary carcinoma is operated upon, and the disease is strictly confined to the breast, the five year recoveries are reported from 70 to 100 per cent. Experience shows, however, by the recurrences which take place, that often when the disease is supposed to be confined to the breast, it has already given rise to metastasis, either by permeation, or embolus through the lymphatics, or even at times by embolus through the blood stream. Experience also shows that when the axilla apparently is clear, there are still axillary lymph nodes present. *White*[11] *has analyzed 195 operable cases and found, clinically, the axilla diseased in 38 per cent. Following operation when there was a careful microscopical examination made, 51 per cent of these 195 cases showed axillary metastasis. Therefore, the absence of palpable disease in the axilla does not prove that no disease is present, and for that reason, it is probably advisable to utilize postoperative irradiation in all cases of carcinoma of the breast, even if no axillary involvement has been demonstrated.* When disease is present in the axilla then the percentage of cures from operation alone varies between 15 and 25 per cent. *Taking a fair average of approximately 22 per cent of five year recoveries from operation alone in this group, it is shown by records in the literature and our own experience that more than double this number of five year recoveries occur when thorough postoperative irradiation is given.* Therefore, the postoperative irradiation is at least equal to the importance of the operation itself.

TABLE IV

RELATION OF THE DURATION OF THE RECURRENCE BEFORE BEGINNING TREATMENT TO THE DURATION OF LIFE AFTER TREATMENT

	Time of Beginning Treatment after Discovery of Recurrence in Months							
Months	1	2	4	6	9	12	18	24+
No. of cases	78	70	69	66	24	66	10	24
Average duration of life in months	53	48.9	43.2	30.7	15.0	24.3	41.7	34.7
Percentage of patients alive in 3 years	41	30	33	27	12	23	30	29
Percentage of patients alive 5 years	23	23	20	13	4	10	20	21

We have treated 400 patients in whom operation and irradiation were combined as follows:

TABLE V

ALL PATIENTS TREATED BY BOTH OPERATION AND IRRADIATION—400 CASES—ALL GRADES

	Alive 3 years	Alive 5 years
No glands at operation	74% of 150 cases	61% of 121 cases
With glands at operation	55% of 250 cases	41% of 222 cases
Total	59% of 400 cases	48% of 343 cases

Of the 111 patients alive in three years in whom no glands were found at operation, 6 were alive but there was clinical evidence of disease still present. Of the 39 patients listed as dead, 5 could not be traced and were counted among the failures. Of the 74 patients alive in five years in whom no glands were found at operation, 3 were alive but there was clinical evidence of

disease. Of the 47 patients listed as dead, 3 could not be traced and were counted among the failures and 1 died of intercurrent disease.

Of the 139 patients alive in three years in whom glands were found at operation, 5 were alive but there was clinical evidence of disease still present. Of the 111 listed as dead, 3 could not be traced and 1 died of intercurrent disease. Of the 91 patients alive in five years, 6 were alive but there was clinical evidence of disease. Of the 131 listed as dead, 7 could not be traced and 5 died of intercurrent disease.

Of the 400 patients in whom operation and irradiation were combined, 178 were regarded as early cases in which there was no microscopic evidence of axillary involvement at the time of operation or at the time of irradiation, which show 86 per cent three year recoveries and 80 per cent five year recoveries.

The above tables do not include those treated by the Keynes method. It must be remembered that, in contrast to surgical statistics, the duration of life is figured from the time of beginning radiation treatment and not from the time of operation or the time of discovering the disease. In some cases this is a period of months and even years after the operation so that the duration of life from the beginning of the disease, or from the time of operation, is much longer than our records show, which are figured from the time of beginning irradiation.

SUMMARY AND CONCLUSIONS

1. This study is based upon a review of the treatment of 1,129 cases of carcinoma of the breast, by means of irradiation, giving the technique and the results.

2. An accurate estimate of the extent of the malignant disease is essential to successful treatment by irradiation.

3. Detailed attention to technique in irradiation of carcinoma of the breast is as essential as careful technique in surgery.

4. All cases operated upon for carcinoma should have skilled postoperative irradiation.

5. In the operable cases with axillary glands a little more than twice the number of cases may be expected to be well after five years when irradiation is added as compared with surgery alone.

6. When there are no contraindications to surgery, with our present knowledge, the combined treatment is probably best, but when surgery cannot be used, irradiation alone, if done skillfully and thoroughly, seems to accomplish nearly as good results.

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DOSAGE AND TECHNIQUE IN THE TREATMENT OF CARCINOMA OF THE UTERINE FUNDUS WITH RADIUM*

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MANY problems confront the radiologist in the selection of adequate uniform dosage and the employment of the proper technique in treating carcinoma of the uterine fundus.

There are two important considerations governing treatment. In the first place the primary lesion is hidden, so that there is no exact delimitation of surface extent or depth. This unfortunate feature prevents the exact placement of applicators. In the second place, the growth is always infected secondarily, many patients presenting themselves with necrotic and sloughing lesions.

These two features demand the utmost skill in interpretation and management by the surgeon and the radiotherapist. Obscure carcinomatous lesions as a rule are not favorable for radiation treatment, since for the planning of uniform dosage it is preferable that the exact character and boundaries of the lesion be accurately determined by inspection and palpation. Secondarily infected lesions must be carefully treated to clear up the infection as far as possible before proceeding with treatment directed against the malignancy.

As the primary lesion is so inaccessible to accurate therapy, and as carcinoma of the fundus is relatively slow to spread by extension or metastasis, surgery is the method of choice in all uncomplicated early cases. Radium therapy, however, is of great value for many advanced, inoperable lesions, as palliation and occasional cure can be achieved and the risk of operation avoided. Radium is also dependable for treatment in the many cases in which the lesion is not extensive but the surgical risk considerable because of the poor general condition of the patient. Obesity, diabetes, and myocardial degeneration often coexist in these cases. In another group, which we may term "borderline" for operability because the lesion has extended somewhat and might be removed only with considerable risk, or because the patient's general health is only fair, radium treatment should be given a thorough trial. If the carcinoma is not benefited by the treatment, operation may be resorted to later and can then be more conservative. Finally, for carcinomas of high grade, postoperative treatments with radium and roentgen rays are of value in reducing recurrences.

The discussion of dosage and technique is difficult because only general principles can be outlined. The best results with this or any other malignant lesion depend on the most careful study of the individual patient. This, of course, is especially true with carcinomas that are obscurely situated, such as those of the uterine fundus. Clinicians, surgeons, pathologists, and radiologists must cooperate in planning the best form of treatment. The histologic grading of carcinomas at the present time is useful mainly in prognosis.

As a basic principle underlying our technique we consider the intensive broken dose method to be the most efficient procedure. This method permits wider selection of applicators suitable for the individual case, produces gentler and more gradual reaction in the tissues, and less systemic reaction, than the massive dose

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technique. Furthermore, with the advent of any serious complication radiation treatment may be abandoned at once and all efforts directed toward overcoming the complication.

Following careful study of the patient's general condition, and of the extent and nature of the malignant process, treatment is planned. The treatment assigned is classified as "complete," "limited," or "prophylactic." Two further classifications are employed: "modified," if there has been previous radiation therapy, and "recurring," if the growth is recurring after operation or effective irradiation on our own services.

Complete treatment is planned when, judging by the extent of the growth and the good condition of the patient, a "cure" may be expected. Limited treatment is considered if the lesion is too massive for hope of a cure or the general health of the patient too poor to permit a full course of treatment. The purpose aimed at is palliation in these cases. Prophylactic treatment follows radical surgery and is designed to prevent recurrences.

If our radiologic judgment is incorrect, and, after planning a complete treatment, serious complications arise, radiation treatment is stopped and the case is classified as "abandoned." We endeavor to keep the latter list as small as possible.

DIVISION INTO STAGES

Classification then is determined by the general condition of the patient and by the extent of the lesion. The lesions are divided into four stages, depending on anatomic extent, as follows:

Stage 1. In this stage the growth is small. There is slight to moderate infiltration of the wall of the uterus, but such infiltration is limited to the cavity of the fundus and keeps well within the level of the internal os. The uterus is movable.

Stage 2. In this stage the uterus is usually increased in size. The lesion is comparatively large, infiltrating the walls of the fundus and involving one or both cornua, with or without infiltration of the parametrium adjacent to the uterus. The uterus is movable.

Stage 3. In this stage the uterus may be small or large and is usually fixed. The following conditions obtain: (1) definite infiltration of the parametrium on one or both sides which extends to the wall of the pelvis, with limited mobility of the uterus, or infiltration of the parametrium on one side, with fixation of the uterus; (2) more or less infiltration of a large part of the cervix, with carcinoma protruding from the external os, with or without involvement of the walls of the vagina, and a mobile uterus; (3) isolated metastasis to the pelvic lymph nodes, with a relatively small primary growth, and (4) isolated metastasis to the lower part of the vagina, with or without involvement of the inguinal lymph nodes.

Stage 4. In this stage the uterus is usually enlarged and fixed. There may be (1) carcinomatous perforation of the wall of the uterus extending to the wall of the pelvis, with or without massive infiltration of the parametrium; (2) carcinoma involving the retroperitoneal or lumbar lymph nodes, or possibly the ovaries, fallopian tubes, intestines, bladder, rectum, or labia; (3) infiltration of the entire uterus, or of one or more walls of the vagina along its entire length, with fixation of the primary growth; (4) remote metastasis; (5) involvement of the iliac or inguinal lymph nodes, and (6) general carcinomatosis. All extensive lesions not placed in the fourth stage will be placed in the third.

TREATMENT OF LESIONS OF THE VARIOUS STAGES

Complete treatment should be carried out for patients in stages 1 or 2 and those in stage 3 for whom the outlook is more favorable. Following diagnostic curettage and careful pelvic examination the first application of radium is placed high in the fundus at the very depth of the uterine canal. In our technique the applicator consists of a brass container which holds two

radon tubes in tandem. Each tube contains approximately 50 millicuries of radon in glass which is placed in a silver tube the wall of which is 0.5 mm. thick. The two silver tubes are contained in a brass capsule whose wall is 1 mm. thick; this completes the applicator. A long, doubled, copper wire is threaded through the end of the applicator for treatment of the fundus. The wire is covered with gauze and folded up inside the vagina and the applicator is left in place for from twenty to twenty-four hours. Three days later a second similar treatment is given in the anterior portion of the fundus. The applicator is moved to the depth of the uterus, and is then retracted back to the internal os and again left in place twenty to twenty-four hours. If the fundus is unusually deep, a third application, in about the middle portion of the uterine canal, is applied for the same length of time. In the event the uterus is normal or only slightly increased in size, the time for the second application should vary from ten to fourteen hours. Applications are made with the patient in the knee-chest position. Anesthesia is not needed for these treatments, but a hypodermic injection of hyoscine, morphine, and cactin (cactoid) is given. Our purpose is homogeneous irradiation of the entire uterine canal, as the extent of the malignancy cannot be definitely outlined. The intrauterine treatments are followed by three applications in the vaginal cavity. The vaginal applicator usually consists of 50 mg. of radium sulphate (element) in a monel metal capsule, the wall of which is 1.5 mm. thick. This monel metal capsule is enclosed in a lead capsule, with walls 2 mm. thick, and both are then placed within an envelope of para-rubber. The walls of this last are 1 cm. thick. The vaginal applications are made daily, one transversely, across the face of the cervix, for fourteen hours, and one in each fornix for the same length of time. The intrauterine and vaginal applications comprise the complete treatment.

In cases in which lesions are in stages 3 or 4, the cervical canal may be involved in the malignant process. If the uterine canal can be probed, the intrauterine applications are given as described. In addition, the cervical canal is irradiated. A tube containing 50 mc. of radon, filtered through 1 mm. of brass and 0.5 mm. of silver, is placed in the anterior portion of the cervical canal for a treatment usually of ten to fourteen hours, the duration depending on the amount of infiltration of the broad ligament that may be present. A four-ply linen thread attached to the tube is wound up in the gauze that fills the vagina and packs away the bladder and rectum. In three or four days this treatment is repeated. Then, in another three or four days, a third treatment is given in which the tube is applied to the middle of the cervix, almost to the internal os; this treatment is later repeated. So, in four treatments, from 2,000 to 2,800 mc-hr. is given in two weeks' time throughout the cervical canal.

For metastasis to the vaginal wall, needles containing 1 mg. of radium sulphate (element) filtered with 0.4 mm. of platinum, are distributed throughout the growth, an attempt being made to place one needle in each cubic centimeter of tissue. The needles are left in place, as a rule, for forty-eight hours.

For metastasis to the inguinal nodes radium surface packs are used. The groins are marked out into areas, about 2.5 cm. square, like a checker-board. Fifty milligrams of radium sulphate (element), enclosed in 1.5 mm. of monel metal and 2 mm. of lead, is used over each square at a distance of 2.5 cm. (we have found blocks of balsa wood to be convenient in maintaining this distance). Three or four areas are treated at one time for fourteen hours until all the areas outlined have been exposed.

Limited treatment, which is applied when lesions are in stages 3 or 4 and palliation only can be anticipated, consists perhaps of only one intrauterine application, if the fundus can be probed, and one or two cervical or vaginal treatments,

which are designed to lessen bleeding and discharge and to relieve pain.

Following radical hysterectomy, three vaginal applications by the methods just described comprise the prophylactic treatment.

At the completion of the radium applications, treatments with roentgen rays are usually employed. Four large fields over the abdomen, anterior, posterior, and two lateral, are treated by employing 200 peak kilovolts, a filter consisting of 0.75 mm. of copper and 1 mm. of aluminum, a focal-skin distance of 50 cm., and 5 ma. of current for 70 minutes.

Pyometritis may complicate the case, and, with the occurrence of adequate drainage of the fundal discharge, active measures are not necessary for its control. In some cases, however, cervical infiltration blocks the uterine discharge, and in this event a suitable catheter is placed in the uterine canal. With gentle suction, or by gravity alone, it may be possible to remove the discharge. Following this a like amount of aqueous bactericidal solution is introduced with only hydrostatic pressure, and the catheter is then removed. In some cases, however, the catheter may be left in position, the vaginal cavity being lightly tamped with gauze to hold it. Two or three times a day a suitable amount of the irrigating solution is introduced into the uterine cavity. The vaginal pack and catheter should be changed every twenty-four hours. The presence of the catheter in the cervical canal for two or three days tends to iron out this canal, which usually is a sinus with rough and irregular walls, thus affording satisfactory drainage of the uterine cavity.

SUMMARY AND CONCLUSIONS

Our present technique in the treatment of carcinoma of the uterine fundus by radium is described.

The basic principle consists of intensive application by the broken dose method and the use of simple applicators, which are gamma-ray tubes containing 50 millicuries of radon, as the unit of treatment; this permits wide choice so that treatment can be individualized. As the lesion cannot be accurately outlined, our purpose is adequate homogeneous irradiation of the uterine canal, including the cervix when involved, supported by vaginal irradiation. Radium element needles are employed in cases of metastasis to the vaginal wall and surface packs are used if the inguinal lymph nodes are involved.

Treatments with roentgen rays are given following the course of radium treatments, especially in inoperable cases and in those in which the lesions are of a high grade of malignancy.

Results reported elsewhere[1] have been encouraging. The whole problem is mainly surgical, although when operation is contraindicated many lesions may be satisfactorily arrested or apparently "cured" by careful irradiation.

In inoperable conditions, palliation is usually secured by limited treatments, and it is an inestimable boon to the unfortunate patients.

[1] Bowing, H. H., and Fricke, R. E. Radium as an adjunct to surgery in the treatment of carcinoma of the fundus of the uterus. Am. J. Roentgenol. & Rad. Therapy, 1931, *26*, 738–745.

PIGMENTED MOLES AND THEIR TREATMENT*

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A PIGMENTED mole, usually spoken of as nevus pigmentosus, melanotic nevus or benign melanoma, may be of several varieties, varying from the small non-elevated pigmented macule to the large verrucous or papillomatous giant nevus which occupies large parts of the body surface.

This type of lesion is usually benign. They are supposedly epidermal fetal rests that may manifest themselves at birth or may lie dormant for varying periods of time and appear as late in life as the adolescent period or later. This type of tumor persists throughout life without other change than a very slow gradual extension until it reaches mature growth, which extension is most marked during the growing time of the host.

The term "mole" usually includes only the smaller members of this family which may be hairy or smooth, elevated or macular.

Histologically the nevus consists first of nevus cells which are usually cuboidal with large swollen nuclei always arranged in groups, rows, columns, or multinuclear nests in the superficial portion of the corium and more deeply in the corium as a dense tumor formation; secondly, of pigment or melanin found in varying intensity in the basal layer of the epidermis, a small amount through the rete about the basal layer of the hair follicle, mostly in the nevus cells themselves and third, in the chromatophores or spindle shaped cells, frequently branching, which lie in the superficial part of the corium mostly among the nevus cells and serve only as pigment carriers as they give a negative dopa reaction.

For many years there was much controversy as to whether these nevi, the nevus cell and the cell manufacturing melanin arose from the epidermis or corium. It is now nearly universally conceded by Bloch and his followers that melanin is manufactured only in the epidermis, chiefly the basal layer or cells arising from this structure except in the instances of the Mongol fleck and the blue nevus, in which instances pigment is produced by the melanoblast lying deep in the corium, arising from fibrous connective tissue cells of this structure. Pigment producing cells give a positive dopa reaction, or oxidation of dioxyphenylanilin shown by gray to gray black to black staining of the cells in frozen section or in frozen section after twenty-four hours' formalin fixation.

Foot of Cincinnati, and Laidlaw of New York, present an argument in favor of the neurogenic origin of these nevi, coinciding with the theory of Masson.

Laidlaw uses the following facts as the basis for this hypothesis: (1) Pigmented moles are rich in nerve fibers and tactile cells as shown in special silver stains. (2) End bulbs of nerve fibers make exact contact with nevus cells as they do in normal skin with the tactile cells of the epidermis and of hair follicles. (3) In its elevation, pigmentation, innervation and grouped tactile cells in the corium, moles resemble the tactile spots of reptiles and amphibia.

In the course of evolution, reptilian tactile spots were replaced by mammalian hair follicles (cat whiskers, etc.). The hairy pigmented mole appears to be a link or transition from pigmented tactile organs of mammalian type. In its hair follicles it is mammalian. In its pigmented elevated character it is reptilian-amphibian.

* From the Department of Dermatology and Syphilology, George Washington University. Read before the Radiological Conference, Washington, D. C., January 26–27, 1934.

If one is to treat melanotic tumors he must be able to recognize the blue nevus which has deeper blue black color and a much deeper deposition of pigment and is recognized as a much more dangerous tumor to handle. Malignancy from this tumor or from the Mongol macule is a true melanosarcoma, which metastasizes quickly and usually to the lung. Any amateur manipulation or stimulation of this lesion is dangerous and foolhardy.

Malignancy arising from the melanotic nevus is necessarily a melanocarcinoma since it arises from epidermal structures. This has for many years been wrongly called melanosarcoma.

Another type of malignancy arising at the site of moles, both pigmented and non-pigmented, is the epithelioma, both basal cell and prickle cell in type. Halkin strongly advises careful wide excision coagulation, not only of the epithelioma but the nevus which has been pushed down into underlying tissues.

The fact that the mole is capable of becoming the most malignant of all malignant tumors is certainly an argument for its removal if that removal can be accomplished without danger to the patient, although the possibility of this accident is certainly not greater than 1 : 1500.

What rôle does irritation play in changing a comparatively harmless pigmented mole into fatal malignancy? Why can a lesion on the sole of the foot withstand eighty years of scraping around in a shoe, or a mole in the beard be cut at more or less regular intervals without undergoing any apparent permanent change while just one splinter of steel, as in a case reported by Evans, may start the explosion? I have no plausible explanation except that in the few cases in the literature and among our own cases where we could carefully check the anamnesis, there always seemed to be infection, the irritation of which, or its resulting inflammatory reaction appeared to be much more irritating than the contusion itself.

Fig. 1. Blue black pigmented mole that started rapid growth after the use of "molex," a preparation advertised for removal of moles and blemishes by home application.

Fig. 2. Showing sloughing and reaction on the twelfth day after coagulation for biopsy purposes and hypermassive roentgen therapy (technique described in text) for a malignant lesion of the lip. The end-result will be a very satisfactory, smooth pliable scar.

There seems to be no doubt among all observers of these lesions that irritation is a direct factor in the production of malignancy. Therefore any pigmented mole that is located at belt, collar, garter line, or under tight clothing, should be removed before it becomes enlarged. Among the dangerous irritating factors we should mention severe sunburning. Those moles in the scars from furuncles, pyodermic lesions and trauma should be removed. A mole should always be removed as soon as possible after it has been subjected to a blow or other contusion. When it becomes inflamed, or shows rapid or sudden change in color, especially becoming darker, it should be removed. There is one type of melanotic lesion that usually starts as a pin point to pin head spot anywhere up to thirty-five years of age, is always mistaken for a comedone and squeezed, after which

FIG. 3. End-result after bipolar coagulation down to periosteum and heavy roentgen-ray dosage. Showing smooth pliable scar. The original lesion was a black, fast-growing melanoma the size of a quarter.

it occasionally grows vigorously. This lesion must be destroyed especially widely since it has a tendency to recur at a distance of 0.5 cm. from the original lesion without local recurrence. We have had experience with at least three of these lesions in persons twenty-seven, thirty-two, and thirty-five years of age. All were rapidly increasing in size. All were desiccated widely. One of these lesions showed four recurrences over a period of two and a half years, none of these recurrences in any instance being within the desiccated scar. The first recurrence was malignant histopathologically. The question as to whether this particular type of lesion is malignant from the time of its appearance or later is one that can only be decided by watching the lesion at its beginning and obtaining early biopsy.

There are three, or possibly four, methods of procedure accepted by different groups as means of removal of the pigmented mole, whether growing or quiescent. First, complete surgical excision by cold knife with a good half inch of healthy tissue on every side and beneath as recommended by Bloodgood, Francis Carter Wood, Coley and Houget and many other good surgeons, most of whom heartily condemn all other methods of procedure. Handley advises complete dissection of the lymphatics. Surgical incision for biopsy or incomplete excision is hopelessly and inexcusably bad technique. Bloodgood advises cautery after malignancy begins. Of about 400 cases of proved melano malignancy, other than metastases from the eye, that we have been able to collect from the literature, surgical failure has resulted in about 99 per cent of the cases at the end of the five year period with 100 per cent cures of the benign mole on all reported cases.

The second accepted method of treatment is by means of roentgen or radium irradiation, as early advocated by Pusey, later by Frazier, Simpson and others. It is a well-known fact that melanotic tumors, especially benign tumors, withstand almost, if not as much, irradiation as normal skin. Evans and others advise hypermassive, soft unfiltered roentgen radiation 62 kv. eff. (6 in. spark gap), no filter, 28 cm. or 11 in. target skin distance, 5 ma., for 20–25 minutes, producing slough, all given in one dose. Evans and many of his adherents also condemn all other methods as inadequate and perilous. By roentgen ray or radium alone or combined with surgery, the mortality rate is lower than by surgery alone. McEuen reports 2 cures in 6 cases

FIG. 4. Low power photomicrograph showing beginning melanocarcinoma in a pigmented mole from the thigh of a three year old child.

of proved melanocarcinoma, Evans 3 cures in 30 after five years. Cures by Holfelder, Ratera, Pusey and others have been reported.

The third method of treatment is by blocking well away from the lesion with novocaine, being careful not to infiltrate the lesion itself, and then thoroughly desiccating first just beyond the border of the lesion, gradually working under it to seal up the blood vessels and lymphatics, then gradually desiccating from the edge toward the center. This is followed by gentle curettage not deep enough to cause bleeding, and further desiccation of any pigmented spots which are frequently uncovered by the curettage, finally finishing by light desiccation over the curetted area, as advocated by Clarke et al. This method of treatment has been in use in our office by Dr. Simpson for twenty years, and by both of us for nine years, during which time hundreds of benign moles, melanotic and white, have been treated. Combined with these are many thousands treated by Black, Wyeth, Pfahler, Eller, and others, without malignancy developing which could be placed directly at the feet of the method done thoroughly. A recurrence in situ is the best evidence that treatment was not complete, not that the method chosen was wrong. Incomplete desiccation is as thoroughly wrong as incomplete treatment by any other method chosen. It is very seldom that one finds a melanotic nevus so superficial that it can be desiccated without leaving a scar, but the scar always fills in well and in most instances is hardly noticeable after a period of time, the cosmetic results comparing very favorably with those attained by surgery or any other accepted method.

In a rapidly growing mole, in one suddenly becoming much darker in color, in the blue nevus and the clinical melanocarcinoma, there are two methods of procedure. First, hypermassive unfiltered roentgen radiation without biopsy, and second when biopsy is necessary the use of the cautery knife after the lesion has been carefully surrounded with a coagulated area. Bipolar coagulation, if this method is chosen, should always be used in this class in preference to desiccation. If malignancy is found or there is any question of malignancy, this should by all means be followed with hypermassive roentgen therapy. In proved melanocarcinoma, lymphatics and lymph nodes draining the area should receive deep roentgen therapy whether or not they are enlarged or palpable.

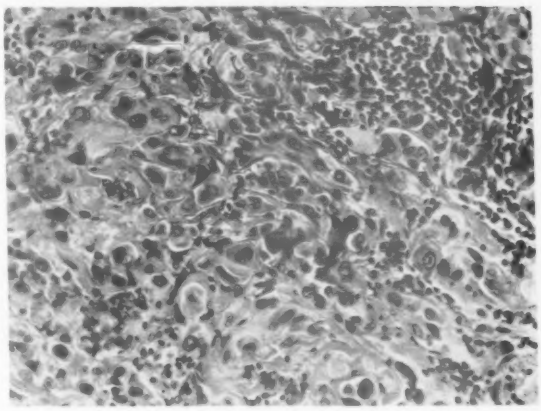

Fig. 5. High power photomicrograph of same case as Figure 4 showing mitotic figures and beginning undifferentiation of cells.

Frequent examination of all cases must be insisted upon for very obvious reasons.

These treatments, or combinations of these three, are the accepted methods today; CO_2 snow, acids, electrolysis, and all other methods are antiquated and condemned as unsafe. Any of them are probably safe in the hands of the expert exponent of a method in the handling of the simple mole; all are dangerous in the hands of the inexperienced. Since the advent of newer roentgen and radium methods, together with the more skillful use of combined surgical endothermy and diathermy, more cures of the malignant pigmented tumors have been reported than before their time, when surgery was the only method used. We, by our method, have apparently cured many surgical recurrences, ranging from small spots to black, fast-growing tumors, two after surgery and

radium of unknown dosage. By apparent cures we mean no recurrence or signs after three to twenty years. We have had but two serious recurrences to our knowlege. One was in the case previously described. In the second case recurrence occurred not in the primary lesion but at 1 cm. distance. The recurrence was treated, and has not appeared after three years. The primary lesion in this case was a rapidly growing black tumor, the size of a quarter.

The prognosis with melano malignancy is certainly bad, but not as hopeless as fifteen years ago, and twenty years hence should be as much brighter by improvement of old and discovery of new methods of attack.

In the simple mole any of the three accepted methods of approach, if properly done, we believe to be adequate. All of the condemnation in the literature is wrong and unfair. In melano malignancy hypermassive roentgen therapy is undoubtedly superior to past methods of procedure.

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THE RELATIVE VALUE OF SURGERY, RADIUM AND ROENTGEN THERAPY IN CARCINOMA OF THE BREAST*

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THE progress in the development of modern surgery in cancer, the more recent methods of electrical surgery, the discovery of the roentgen rays and radium, have improved greatly our therapeutic results. None the less cancer therapy, even by the aid of all the methods at our command, is far from being perfect.

Surgery, including electric surgery, and radium and roentgen therapy represent today the sum total of the methods we possess in combating the disease. The most important problem is to obtain a true evaluation of these methods of cancer therapy and a correct method for their coordination.

In the years of constant interest and active participation in the development of the subject, I had the opportunity to follow the results of the old methods of surgery, of modern so-called radical surgery as well as of electric surgery, of radium and of roentgen therapy. As a result of these years of study, I feel justified in making the following statement: An individual cancer patient has a far greater chance for recovery at present than thirty years ago. On the other hand, undue enthusiasm over immediate results does only harm to the progress of the work since immediate results must usually be greatly discounted a few years later.

The relative value of surgery and radiotherapy varies with the different types of cancer and depends on the clinical behavior of each type. In order to evaluate correctly these two methods of treatment it is necessary to understand the clinical course of the type of cancer in question and appreciate the mechanism of the action of the two methods of treatment.

The variations in the clinical course of cancer depend upon the preponderance of one or the other phase of malignancy.

The clinical course of cancer, the malignancy of a cancerous growth, is due to two characteristic features of a cancer cell, namely, the capacity of *infiltrating* into and destroying the adjacent normal tissue and of replacing it by cancer cells and the ability of the cancer cell to separate itself from the primary tumor, multiply when transplanted into a new region and thus create secondary *metastatic* tumors.

The infiltrative growth of the cells of the malignant tumors is the main reason for the clinical course which the malignant tumors take and for the ultimate destruction of the organism of the host. The cancer cells use up the food of the adjacent normal cells and, what is of greater importance, injure and subsequently destroy these normal cells.

Such deterioration and ultimate destruction of normal adjacent tissue and its replacement by tumor tissue continues progressively until the wall of a main artery is destroyed and the patient dies of a hemorrhage, or a wall of an organ is destroyed or a serous cavity is perforated and the patient dies of secondary infection or destruction of a vital organ.

The mechanism of the formation of metastases in malignant tumors consists of the following phases: (1) the detachment of a group of cancer cells from the primary tumor; (2) the transportation of this group of cells into distant parts of the organism, and (3) the proliferation of these cells in the new location and the consequent formation of secondary metastatic tumors.

The experimental as well as clinical investigations[1] which I have conducted on the mechanism of formation of metastases in cancer indicate that tumor emboli are transported everywhere with the same ease and find lodgment in any part or organ

* Read before the American Congress of Radiology, Chicago, Ill., Sept. 25–30, 1933.

of the body. The further growth, on the other hand, of a small transported group of cancer cells and its development into a large metastatic tumor depends upon a correct metabolic affinity between the cancer cells, on one hand, and the organ cells, the soil as it were, on the other. A metastatic tumor forms only when the transported cancer cells succeed in overcoming the inhibiting powers of the normal tissues of the new locus. Malignant tumors derived from different organs and tissues show great variations in the frequency and rapidity of the formation of metastases.

The following two instances show clearly these variations in the modes of malignancy and consequent variations in the clinical course. Cancer of the cervix involves the surrounding normal tissues (rectum, urinary bladder, uterus and blood vessels) and regional lymph nodes. Very rarely are metastases formed in distant regions and then only late in the course of the disease. In carcinoma of the breast, metastases in the distant regions (distant lymph nodes, lungs, liver, skeleton) appear frequently and early in the course of the disease.

This ease and readiness with which distant metastases are formed in cancer of the breast must be taken into consideration in the selection of the therapeutic procedure for the various stages of the disease. This choice becomes even more difficult since two cases of cancer of the breast in the same stage of development may differ in their clinical course, showing greater or lesser rapidity of the local growth and great variations in the frequency of the occurrences of distant metastases. A scirrhous carcinoma of the breast may remain localized for years without disturbing the rest of the organism while a medullary carcinoma may kill the patient in a few months or even weeks. In some cases the carcinoma of the breast which appears to be in a comparatively early stage will recur locally soon after a most extensive operation, while throughout the whole subsequent course of the disease no distant metastases will be noted anywhere. In other cases the result of the operation will be apparently perfect, there will be no local recurrence and yet, as late as twenty years after the operation, a metastasis will occur in the head of a femur or in the pelvic bones.

The following case may indicate how slow a course a carcinoma of the breast may take even with inadequate methods of treatment:

Miss L. D., aged fifty, consulted me in April, 1926, giving the following history. In June, 1921, while residing in Shanghai, China, she noticed a lump in the right breast. A local excision of the tumor was done in the General Hospital of Shanghai and no malignancy was found. In October, 1923, a recurrence of the tumor was noted. Again only a local excision was done, malignancy found and the operation was followed by roentgen and radium treatment but the patient did not complete the course.

On examination I noted two scars over the anterior surface of the right breast. On palpation a diffuse hard and nodular mass was noted in the lower inner quadrant of the breast, measuring about 2 cm. in diameter and adherent to the lower scar but freely movable over the chest wall. No lymph nodes were palpable in the axilla or supraclavicular region. The left breast appeared normal. The patient was advised to undergo a preoperative course of radiotherapy to be followed by a mastectomy. The patient, however, left before the course of radiotherapy was completed or the mastectomy done. She again consulted me on September 14, 1932, six years later. At this time the tumor in the right breast was found somewhat larger, a tumor was palpated in the right axilla and also in the left breast. There were several subcutaneous nodules in the skin surrounding the right breast. No metastases were found in the lungs, liver or skeleton. I then did a double mastectomy with wide excision of all the skin around the right breast containing the metastatic nodules. Microscopical analysis showed adenocarcinoma. Now one year later the patient shows no local recurrence or metastasis anywhere. She has had postoperative irradiation since.

All these peculiarities and variations in the clinical course of cancer of the breast,

the difference in the mechanism of the action of surgery, radium and roentgen rays, as well as their respective limitations, must be kept thoroughly in mind in order to reach the correct conclusion as to the therapeutic methods to be employed for each individual patient.

In the following lines the mechanism of the action and the applicability of these therapeutic agents will be discussed separately.

MODE OF ACTION OF SURGERY IN CANCER

In the course of the last thirty years much progress has been achieved in the surgical treatment of cancer. The so-called radical methods of operative procedure were developed as a result of anatomical studies of the distribution of the lymph channels through which the disease spreads.

An excellent example of such studies is the anatomical and pathological investigations of Handley[2] on cancer of the breast. He has shown that groups of cancer cells from the primary tumors in the breast permeate into the lymphatic vessels of the deep fascias of the chest wall. Subcutaneous nodules of recurrence arise only subsequently from the permeated fascial lymphatics along its tributaries. As a result of his investigations Handley proposed certain improvements in the methods of the surgical amputation of the breast for carcinoma as previously elaborated by Halsted and Willy Meyer. Handley considered the following to be the object in surgical removal of the breast for carcinoma: "The removal intact of the permeated area of the lymph vascular system which surrounds the primary growth and of the lymph nodes which may have been embolically invaded along the trunk lymphatics of the area concerned." Thus modern surgery strives to remove all the normal tissues adjacent to the malignant tumor and into which the latter spreads most frequently and also to remove all regional lymph nodes. By the aid of these methods very remarkable results may be obtained in the so-called operable cases.

Electric Surgery. About twenty-five years ago it was definitely established that the physiological effect of high frequency currents on the organism is the production of Joule's heat, i.e., heat which is developed throughout the tissues located between the two electrodes. Immediately after this discovery high frequency (*diathermic*) currents began to be employed for the surgical destruction of malignant tumors in situ.

The following physical phenomenon makes such a destruction possible. The intensity of the heat which develops under the influence of the same current in the tissues between the two electrodes is in inverse ratio to the size of the electrodes. When the electrodes are very small, the tissue is heated to such a degree that it undergoes a state of *coagulation necrosis.* This method of heat destruction of tissue is called *electrothermic* or *diathermic coagulation.*

The surgical coagulation of tumor tissue may be accomplished in two ways. Either two small active electrodes of the same size are placed over two opposite ends of the tumor, and then the coagulation takes place in the part of the tumor located between the two electrodes, or when the tumor is situated in the mouth or another cavity, then the two electrodes cannot be applied and another method has to be employed. This method consists in applying one large neutral electrode over the back, abdomen or some other part of the body of the patient and another small active electrode over the part of the tumor to be coagulated. By this method the coagulation takes place in the neighborhood of the active electrode, while the tissues in the area of the large electrode are only heated to a slight degree. This method is simple technically, but the depth of coagulation cannot be controlled. Furthermore, the high frequency currents passing through the large neutral electrode may be followed by both local and general deleterious effects on the organism.

To obviate these difficulties I devised[3] a *double active electrode* placed in one

handle with a double cord. The electrodes are built in a straight or curved line with flat or sharp points. With this electrode it is possible to enter with ease into the oral or other cavities and to do the coagulation without injuring the adjacent tissues. When a diathermy machine is used with a large neutral electrode and a needle point for an active electrode the latter acts like an electro-knife. This knife may be superior to an ordinary scalpel when the excision is close to the tumor, since it coagulates a thin layer of tissue besides cutting it and closes up the lymph and blood channels. As a result, there is less chance of bleeding as well as of dissemination of minute particles of tumor tissue.

Both *diathermic coagulation* and *high frequency electric cutting* represent only an additional technique in cancer surgery, have no specific action on cancer tissue and their value should not be overestimated.

LIMITATIONS OF SURGERY IN CANCER

The technique of cancer surgery can hardly be improved further. Malignant tumors are usually situated in close proximity to vital organs, the injury of which would endanger the life of the patient; consequently there is set a limit to the length to which a surgeon may go in removing normal tissues adjacent to the tumors. As a result of these limitations there may remain small islands of cancer cells in or near the operating field even after a most extensive radical operation. Such a permeation of cancer cells into lymphatic vessels at a distance from the primary tumor may take place even when the regional lymph nodes do not show metastatic tumors, as is well demonstrated in the following case:

Mrs. F. B., aged forty, came to me on November 4, 1930, with a history that she had noticed a lump in the left breast three weeks before. Examination showed a tumor mass in the upper outer quadrant of the left breast. No lymph nodes were found in the axilla or supraclavicular region and no metastases elsewhere. I performed a mastectomy on November 10, 1930. No metastatic lymph nodes were found in the axilla. This was followed by radiotherapy. One year later a local recurrence developed in the anterior axillary line of the incision for which excision and radon insertion were done on three occasions. At present, nearly three years after the mastectomy, the patient shows no metastases and is in good condition.

In the course of thirty odd years of work I have done several hundred radical mastectomies with the usual technique and the usual percentage of five year cures. The failure of radical surgery in the case reported above was due to permeation of cancer cells throughout the chest wall without involvement of the axillary lymph nodes. More important is the fact that even in an apparently early operable stage of the disease there may be present minute tumor nodules in distant organs which subsequently develop into large metastatic tumors. Electric surgery may improve some of the results, but if permeation takes place before the operation then even electric surgery is powerless.

MODE OF ACTION OF RADIOTHERAPY IN CANCER

The term radiotherapy is usually applied to treatment by the aid of both radium and roentgen rays. It is as yet difficult to ascertain whether there is a qualitative difference between the biological and therapeutic action of the two types of radiation. It seems that the more penetrating the radiations are, the more selective is their biological action, and the gamma rays of radium are more penetrating than the hardest roentgen rays at our command at present. None the less, the gamma rays of radium represent, from the standpoint of physics, only a more perfect type of roentgen rays and the biological action of the two types of radiations must be to a degree analogous.

The morphologic changes which occur in carcinoma or sarcoma tissue under the influence of radium and roentgen rays are observed in the tumor cells themselves

and are manifested by the coagulation of the protoplasm, pycnosis of nuclei, karyolysis and, ultimately, complete necrosis of the cell. The cellular changes are accompanied by a round cell infiltration, which is subsequently changed into dense sclerotic connective tissue, poor in blood vessels. This new connective tissue formation ultimately dominates the picture to such an extent that some observers maintain this to be the only direct effect of radiation, while the destruction of the tumor cells is secondary and due to lack of nutrition.

The clinical, pathological and biological studies[4] of myself and my associates indicate that the first effect of the rays is exerted directly on the tumor cells. This effect consists in the inhibition of the proliferating power, in the *sterilization*, as it were, of the cancer cells. The degeneration and destruction of the cancer cells and the formation of the sclerotic connective tissue takes place, subsequently, through the action of the rays; moreover, this cell degeneration and cell death may not be due directly to the action of the rays, but takes place in the natural course of the life cycle of the cancer cell. This cycle consists of *youth* or period of development, *maturity* or period of function and *senility* or period of degeneration, which gradually leads to death. In parenchymatous organs like the liver or kidneys, the first period is usually completed during embryonic life or at a very early age; the second period continues through the whole life of the organism, the third period is attained at the old age of the organism or near its death. The life of an individual cancer cell, on the other hand, is very short; it changes rapidly from an embryonic into an adult and then immediately into an aged, degenerated cell, and this process takes place continually, irrespective of any intrinsic aid. However, the majority of cancer cells of a malignant tumor are quickly rejuvenated before they reach senility through the fact that each cancer cell is divided into two young daughter cells. The irradiation arrests the division of the cancer cell and as a result, the latter matures and degenerates. A certain number of such mature cells may not degenerate and, though potentially cancer cells, may become resistant to the rays.

The round cell infiltration which surrounds the groups of irradiated cancer cells, and which is subsequently changed into dense sclerotic connective tissue, occurs subsequently but for the purposes of the therapy it is possibly of greater importance than the destruction of the cancer cells themselves. The important rôle of this connective tissue consists in the following. After the most perfect results of irradiation, as stated above, there may remain a certain number of viable though stunted cancer cells; the dense connective tissue wall surrounds these cells and keeps them in check.

It is evident from the study of the mechanism of the biological and therapeutic action of radiation that it is superior therapeutically to surgery because it may either destroy in situ or inhibit malignant tumor tissue without injuring or removing any of the adjacent normal tissue. Thus, theoretically, radiotherapy is the nearest approach to the specific method of treating cancer we can conceive of today. However, as will be shown later, in practice, radiotherapy, notwithstanding its biological advantages, has its limitations as well as has surgery.

Radium Therapy in Cancer. It was stated above that the biological and therapeutic action of radium and roentgen rays is quite analogous. None the less, there are certain phenomena in connection with the action of these two agents which indicate the superiority of the gamma rays of radium over roentgen rays. A beam of rays travels from the point of its formation in the form of a pyramid. The farther away from the apex it travels the more diffuse it becomes. The closer, therefore, the surface of the part to be irradiated is to the apex of the pyramid, the greater

the intensity of the rays. It has been shown that the diminution of this intensity is in inverse ratio to the square of the distance of the surface of the body from the source of the rays. The gamma rays of radium originate within the radium container; consequently when a small cylindrical tube of radium is placed over the surface of, or better still, within a tumor, the distance between the course of radiation and the tissue to be affected is minimal. The roentgen rays, on the other hand, originate at the focal point of the target of a roentgen tube and the distance between this target and the surface to be treated is not less than 30 or 50 cm. As a result a far greater quantity of the roentgen rays must enter the organism of the patient in order to obtain, at the tumor, the quantity needed to influence it. These radiations, however, produce a reaction on normal tissue and particularly on the blood and blood-forming organs, which may become so severe as to counteract the beneficial effect of the rays on the tumor.

Two methods of application of radium are in use at present. (1) *Surface Application of Radium.* A box or pack containing the necessary amount of radium is placed over the surface to be treated. When a very large quantity is used then it is placed in an apparatus which consists of a heavy lead cylinder attached to a movable metal stand. At one end of the lead cylinder there is a small round opening covered with platinum and hard rubber. This surface of the apparatus serves as a filter for the radium and is placed at a distance of from 10 or 6 cm. from the skin. By this method between 5,000 and 12,000 mc-hr. may be given at one treatment.

(2) *Intratumoral Insertion of Radium.* The technique of this method consists in the following. The radon is pumped directly into a gold capillary tube and sealed. This capillary is inserted by the aid of a trocar into the tumor tissue and either left there permanently, or else the gold capillary is placed in a steel hollow needle. The latter is thrust into the tumor tissue, left for a certain number of hours and then removed. For the latter method either radon or radium element may be used.

The advantage of the intratumoral insertion over surface application consists in the fact that the method allows an even distribution of small quantities of radiation throughout the tumor, and that on account of the intimate contact of the source of radiation with the tumor cells, the total amounts are small and local results are obtained without any deleterious general effect on the organism. This method of intratumoral insertion of radon I consider superior in many respects either to the surface application of radon or to roentgen irradiation.

Roentgen Therapy. The methods of roentgen therapy are changing and improving almost daily and today probably nearly as efficient a result may be obtained by high voltage roentgen therapy as with surface application of a radium pack. Through a large field of entry 43 per cent of the skin dose may be delivered to a deeply seated tumor, and with several portals of entry even more than a skin dose may reach the tumor. However, too much emphasis cannot be laid on the fact that such intensive irradiation must be accompanied by dangerously severe irradiation of adjacent normal tissues. Two difficulties are encountered when an attempt is made to influence a malignant tumor with roentgen rays alone. On one hand, some tumors are much more radioresistant than others and on the other hand, the efficiency of radiotherapy in cancer is in inverse ratio to the mass of the tumor. The greater the amount of total tumor mass within the organism, the more malignant is the condition clinically and the lower is the resistance of the organism. I have shown in a previous publication that even metastases in the bones may be clinically arrested when they are not multiple and the primary tumor is removed.

LIMITATIONS OF RADIOTHERAPY IN CANCER

There is no doubt that basic limitations to all the three methods of cancer therapy

exist, which will be impossible to overcome by further progress in the technique. The limitations of surgery were analyzed above. Both radium and roentgen rays exert a truly specific selective action on cancer tissue, and biologically, as was stated above, present the nearest approach to a specific therapeutic measure. The limitations of both agents are due mainly to the size and location of the tumors and the comparative vulnerability of the normal tissues. Radium can be placed in near approximation to or within the tumor. The method of buried radon capillaries obviates to a great extent the difficulties created both by the size and location of the tumor. However, the size and multiplicity of the malignant tumors makes the quantities of radium required so excessive that they may also become injurious to the rest of the organism. Roentgen rays effectively cover simultaneously large areas even in the depth of the organism and influence there the tumor nodules provided they are very small. Intensive roentgen treatment of large tumor masses is followed by severe general reaction of the organism, mainly the blood and blood forming organs which may preclude further treatment for a long time. I constantly examine the blood morphology while the patient is being irradiated. Furthermore, as stated above, cancer tissue may become radioresistant.

COMBINATION OF SURGERY AND RADIOTHERAPY IN CANCER

Limitations which manifest themselves in the therapeutic results of either surgery or radiotherapy in the treatment of cancer are of a character which indicate even a priori the value of the proper coordination of the two methods. Surgery is frequently capable of removing promptly in toto a massive tumor but fails in either locating or removing minute nodules which are attached in the depth of the organism or in the close vicinity of vital organs. Radiotherapy, on the other hand, fails in producing a complete result when acting on a large tumor but may reach and destroy small nodules in any location. The same must be true in the treatment of cancer of the breast. In order to demonstrate the true value of such a coordination it will be well to discuss separately surgery and radiotherapy and show the function of each in the various stages of the disease.

SURGERY IN CARCINOMA OF THE BREAST

Radical surgery in cancer of the breast was the earliest and the most brilliant achievement of the whole field of cancer surgery and in its limited sphere of usefulness gives excellent results. This is probably the main reason why the majority of surgeons even today maintain that surgery alone is the only treatment of value to the patient with cancer of the breast. Before the actual value of surgery in cancer of the breast can be determined, it must be estimated how much surgery can accomplish without the aid of radiotherapy.

In 1929 a committee on the treatment of malignant disease with radium and roentgen rays of the American College of Surgeons[5] reported on cancer of the breast. The committee has tabulated statistically 774 cases from nine hospitals in four towns. This statistical investigation reveals the following: Of the 774 cases studied about 15 per cent showed no glandular involvement, and of these patients about 57 per cent or about 8 per cent of the whole number, remained well for five years. Involvement of the axillary lymph nodes was present in 35 per cent, and of these only 16 per cent, or about 5 per cent of the whole number of patients, remained well for five years after radical operation. Thus not more than 13 per cent of all the cases of cancer of the breast remained well for five years. One must keep in mind the fact that many in this 13 per cent developed recurrences or particularly metastases in distant organs later than five years after the operation. This small percentage of cases which are cured by surgery indicates that while cancer therapy generally and particularly therapy of the cancer of the

breast remains a surgical domain the orientation of the surgeon as regards the position which surgery occupies in the therapeutic armamentarium of cancer of the breast must change. On the one hand, surgery is indicated today much more frequently than was true in the period before the discovery of radiotherapy. On the other hand, surgery should never be considered as the only or even as the most important method of treatment of cancer of the breast but rather as a very important and indispensable adjuvant to radiotherapy.

For the future progress of therapy in cancer of the breast it may be well to discontinue the terms "radical" and "palliative" surgery. The borderline between these two types of surgery in cancer of the breast cannot be well defined and the ultimate result is never certain. On the other hand, much may be accomplished for the individual cancer patient if less thought is given to clinical statistics and more to the special needs of the individual case and to the special requirements of the radiotherapy in the case.

The aim as well as the method of the surgical procedure to be employed varies with the different stages of the disease. The following stages require surgery in one form or another: (1) cases in which either the breast only or the breast and the axillary lymph nodes are involved; (2) cases in which the supra- or infraclavicular lymph nodes are involved; (3) cases in which the primary tumor in the breast is ulcerated or attached to the chest wall, or cases which show a local recurrence after a radical mastectomy, and (4) cases which present malignant tumors in the second breast.

(1) Cases without involvement of any lymph nodes or with involvement of the axillary lymph nodes represent a stage of the disease in which surgery aims to eradicate all the tumor tissue from the organism. Surgery in these cases must be very extensive and thorough. Some methods of radiotherapy, however, must be added as will be seen later even in the earliest cases in order to increase the percentage of success.

(2) Cases with involvement of supra- or infraclavicular lymph nodes represent a stage in which surgery cannot eradicate all the tumor tissue. Complete surgical removal is indicated in these cases because the sooner the main tumor mass is removed the less chance there is for subsequent formation of distant metastases and the more successful the subsequent radiotherapy will become.

(3) Cases in which the primary tumor in the breast is ulcerated or attached to the chest wall or both may require surgery if several weeks after radiotherapy the ulceration is diminished in size and the tumor becomes freely movable over the chest wall though it remains large in size. Surgery in these cases aims not only to remove rapidly the bulky tumor but to make the patient's life more bearable. It is a great comfort for the patient to be relieved of an ulcerating mass of the chest wall. The operation may also, by removing rapidly the remnants of the primary tumor left after the radiotherapy, diminish the chances of formation of distant metastases. Local recurrences after mastectomy are usually adherent to the chest wall and must be treated in the same manner as primary tumors attached to the chest. When a bulky recurrent tumor becomes movable over the chest wall after irradiation it may be removed surgically, otherwise the only surgery indicated is an incision of the skin over the tumor to facilitate the insertion of radon.

(4) The development of a malignant tumor in the *second breast* in a patient with cancer of the breast is not a very rare occurrence. It is difficult to determine in each individual case whether the tumor which developed in the second breast is a second primary malignancy or is a metastatic tumor from the first breast. The treatment, however, remains the same in both instances. The tumor in the second breast, if left untreated, will increase

rapidly in size and will become an active source for the formation of the new metastases. Therefore if the condition of the patient is otherwise favorable the second breast should be removed surgically and then radiotherapy employed. The reason for this procedure is the same as in ulcerated or adherent tumors. In this manner very excellent palliative results may be obtained.

Handley[6] reported in great detail the clinical course of one patient who had a left mastectomy done in 1912, followed by roentgen treatment and radium insertion. Ten years later a right mastectomy was done. The patient died two years later, or twelve years after the first operation, from metastases in the lungs. The following are similar cases from my practice:

E. C., a woman, aged twenty-four, was admitted to the hospital, April 29, 1921, with carcinoma of the left breast and a large tumor in the axilla. I performed a radical mastectomy and inserted capillaries of radon into the axilla and the part of the chest wall corresponding to the breast tumor. This was followed by roentgen treatment and surface application of radium. No metastases were found at the time of operation in the lungs, skeleton, liver or the other breast. In October, 1921, a tumor was found in the right breast with involvement of the axilla. I performed a mastectomy of the right breast with insertion of radon, which was then followed by roentgen treatment and surface application of radon. The patient died January 19, 1929, nearly eight years after the first operation, of pulmonary metastases. With the exception of the last few weeks, the patient was well throughout the eight years.

Miss A. S., aged forty, came for examination on October 1, 1925, with a history that a right mastectomy for carcinoma was done on January 4, 1924. The patient complained of severe backache. Examination showed no local recurrence. There was a hard nodular mass noted in the inner lower quadrant of the left breast, no masses in the left axilla, or supraclavicular or infraclavicular region. Roentgen examination of the chest and skeleton showed an irregular destruction in the inferior surface of the body of the fourth lumbar vertebra. No adenopathy was noted anywhere. Diagnosis was made of metastases in the body of the fourth lumbar vertebra and in the left breast. On October 18, 1925, I did a left mastectomy. Microscopical analysis showed adenocarcinoma. This was followed by repeated courses of radium and roentgen therapy. At present, nearly ten years after the first mastectomy, the patient is in good condition and shows no new metastases.

Mrs. A. L., aged thirty-one, on March 25, 1926, came to me for postoperative radiotherapy after a right mastectomy done by Dr. Willy Meyer on December 5, 1925. A tumor mass developed in the left breast and Dr. Meyer did the second mastectomy on April 30, 1926. The patient has had repeated courses of radium and roentgen treatment since and at present, nearly eight years after the first mastectomy, the patient shows no evidence of any metastases.

RADIOTHERAPY IN CARCINOMA OF THE BREAST

In the same report of the College of Surgeons stated above the general conclusion was reached that roentgen treatment does not improve the results of radical surgery in the early operable cases but that the value of roentgen therapy in the treatment of recurrence after operation is established. These two conclusions are evidently contradictory. If results can be obtained when a recurrence is already established, it should be easier to succeed when the treatment is begun before the recurrence appears and when there are consequently only microscopic islands of cancer cells to overcome. The only plausible explanation of this discrepancy is that in the series of cases studied by the committee the recurrences were irradiated properly while the prophylactic irradiation was given in a half-hearted manner. Indeed the committee admitted that an accurate statement of the details of the roentgen treatment was not possible. "At times low voltage was given, in other hospitals more penetrating radiation was available. Radium was used in only a very small number of cases." This indicates how difficult it is to interpret clinical statistics in the estimation of the relative value of the various methods of cancer therapy.

As a result of over three decades of study, covering a large number of cases of cancer in clinic, hospital and private practice I can fully subscribe to the following statement of Handley: "The key to further advances in the treatment of cancer is not to be found in statistical studies in which larger numbers of cases are superficially studied. It is in the ward and laboratory rather than in the bureau of health statistics that the information we require is to be sought."

As was stated above, intratumoral insertion of radon is the most valuable single agent in cancer therapy. Surface application of radium, on the other hand, is very similar in its action to high voltage roentgen therapy and the two may be frequently interchanged. A small field is more easily treated by radium, while large fields or prophylactic irradiation when the actual location of tumor is not known are best treated by roentgen rays.

Again in radiotherapy as in surgery the method of treatment depends upon the stage of the disease and will be discussed separately for each of the four stages enumerated previously.

(1) Cases without involvement of any lymph nodes or with involvement of the axillary lymph nodes, as was stated above, require surgery as the first step. I do not favor preoperative irradiation in this type of cases since it may delay the operation. On the other hand, postoperative irradiation should begin immediately after the operation and frequently even simultaneously with it. I begin the treatment of these cases with a radical mastectomy and, if the axillary tumor is large and attached to the underlying tissues, buried capillaries of radon are placed in the axilla and in the parasternal region. This is followed subsequently by a course of high voltage roentgen treatment which covers the region of chest and of the pelvis to obviate the occurrence of metastases in the chest or skeleton. Radium packs are placed over the supraclavicular region and in the axilla.

The superiority of this planned systematic combination of surgery with irradiation over unsupported surgery is self evident, since the value of radiation therapy in the treatment of recurrences is admittedly established. It is extremely difficult to offer irrefutable statistical evidence, particularly since a five year cure does not mean that the condition may not return later as a local recurrence or metastasis. However, the number of cases with metastases in the axilla which were kept in good condition for five years and longer by the aid of combined methods is much greater than could have been done with surgery alone.

(2) Cases with involvement of supraclavicular or less frequently infraclavicular lymph nodes are treated by me in the following manner. In the course of the mastectomy a separate incision is made over the clavicle and radon capillaries are inserted into the tumor in the supra- or infraclavicular region and also in the axilla and over the chest wall if necessary. This is followed by high voltage roentgen therapy and surface application of radium.

I have observed many patients who lived in comfort for a number of years after such treatment. The following is an illustrative case:

Mrs. J. S., aged fifty, was sent to me on December 8, 1928, with a history of having noticed a small lump in the left breast two years previously. On examination there was noted in the left breast immediately above the nipple a diffuse swelling about 4 cm. in diameter and about 1.5 cm. in height. Immediately above the swelling there was noted a dimpling of the skin. On palpation there was noted in the area of the elevation a hard nodular mass about 3 cm. in diameter and 2 cm. in thickness. The mass was freely movable over the chest wall. There was a diffuse flat mass palpated in the axilla freely movable over the underlying structures. Two nodules the size of a buck shot were palpated in the supraclavicular region.

Diagnosis was made of carcinoma of the left breast with metastases in the axillary and supraclavicular lymph nodes. On December 21,

1928, I did a radical mastectomy and radon insertion into the axilla. An additional incision was made perpendicular to the clavicle, the nodules were removed and radon inserted into the region. This was followed by roentgen therapy and surface applications of radium. Additional insertions of radon were done subsequently. At present, nearly five years since the mastectomy, the patient is suffering from involvement of the brachial plexus but shows no evidence of metastases elsewhere.

(3) Cases in which the primary breast tumor is ulcerated or attached to the chest wall, or both, and cases of local recurrence after mastectomy represent stages of the disease in which irradiation is the major procedure. It always precedes surgery, and the latter is employed only occasionally. A patient suffering from a large ulcerating tumor of the breast which constantly secretes a foul discharge is a burden to herself and to her surroundings and therefore relief of the condition is urgent. An insertion of radon capillaries is made into and around the ulcerated area of the tumor, occasionally preceded by diathermic coagulation of redundant tissue, and this is followed by surface application of radium and by roentgen therapy. After a period of from four to six weeks the ulcer frequently becomes diminished in size, the tumor shrinks and becomes freely movable over the chest wall. A mastectomy may then be done. Only enough skin is removed to excise widely the ulcerated area and to allow for an immediate primary union. It must be clearly understood that this represents only a palliative procedure. It seems, however, not only to prolong life but mainly to make the life of the patient more bearable. It is much more comfortable for the patient, both mentally and physically, to succumb ultimately to internal metastases then to live for months with a large fungating carcinomatous ulcer. Series of such cases were reported in my previous publications. The following may serve as an illustration.

S. C., a white woman, aged sixty-nine, was admitted to the hospital on May 22, 1924, with advanced cancer of the right breast. On examination there was found a stony hard mass in the upper half of the breast. It was about the size of a grapefruit and was attached to the skin but was movable off the deep structures. There was an ulceration, roughly circular and 6 cm. in diameter, overlying the central part of the tumor. The right nipple was drawn upward toward the tumor. In the right axilla there was a large hard mass which was movable over the underlying tissues. No distant metastases were noted. The diagnosis was proved microscopically. On June 21, radon was inserted into the ulcerated area of the breast. The tumor shrank and the ulceration diminished in size. A mastectomy was performed. The wound healed by primary union and the patient improved rapidly in her general condition. When she was last seen, sixteen months after the operation, there was no evidence of any local recurrence or metastases.

Recurrences of tumors after mastectomy are generally firmly attached to the chest wall and therefore must be treated by irradiation. The only surgical procedure in the majority of these cases consists in an incision over the tumor mass so as to facilitate the intratumoral insertion of radon and possibly in doing a biopsy. Only temporary improvement may be obtained in this group of cases. None the less, as may be seen from the following case, very satisfactory results may follow this course of treatment.

A. E., a woman aged fifty-eight, came to me on October 31, 1927, with a history of having had a radical mastectomy done for carcinoma of the left breast with involvement of the axilla in September, 1926. Examination revealed a local recurrence in the sternocostal junction corresponding to the third and fourth rib. I made an incision over the tumor mass, performed a biopsy, which showed malignancy and did an insertion of radon capillaries. This was followed by high voltage roentgen therapy and surface application of radium. This case was reported over two years ago, and at present, seven years after the mastectomy, there is no evidence of any local recurrence or metastases anywhere. The patient is comfortable and takes care of her work.

(4) The methods of radiotherapy in cases in which the second breast is involved

depend upon the stages of the disease which both breasts show and consequently does not differ from the stages discussed previously.

In cases of cancer of the breast with metastases in the lungs or in the skeleton surgery is not indicated, and these cases therefore need not be considered in this presentation. I showed[7], however, in my previous publications that I obtained remarkable results in this type of cases by the aid of high voltage roentgen therapy and surface application of radium and this is probably the best proof of the general efficiency of radiotherapy in cancer of the breast.

Follow up. It is generally accepted that the sooner in the development of the disease a patient with carcinoma of the breast is examined, the better the ultimate results of the treatment. The same is true of recurrence and metastases. The sooner they are recognized the better the results of the treatment. Therefore every patient with carcinoma of the breast must be under constant observation for many years and must be carefully examined at stated intervals so that every secondary manifestation may be discovered in its incipiency and at once subjected to proper treatment.

SUMMARY

Surgery, radium and roentgen therapy are the only methods in our possession for treating cancer of the breast.

The modern methods of radical surgery in cancer of the breast represent a great advance over the old methods. However, even with the latest methods of surgery not more than 10 per cent of all patients remain well five years after operation.

In view of the small percentage of the successful cases, it is advisable not to differentiate so severely between radical and palliative surgery and on the one hand widen the indications for surgery and on the other hand, use less extensive methods of operating.

Surgery should not be considered as the only therapeutic method but rather as an indispensable adjuvant to radiotherapy.

Electric surgery may improve the surgical results.

Radiotherapy is the nearest to a specific remedy we possess in cancer and is from this standpoint superior to surgery and has a wider applicability.

Limitations of radiotherapy are of such a nature that they may be frequently overcome by a correct coordination with surgery.

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ROENTGEN TREATMENT OF CARBUNCLES

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THE literature on roentgen therapy of inflammatory conditions is abundant, but relatively little has been written in the past few years as to the strikingly brilliant results which may be obtained in the irradiation of carbuncles. Although this method of attack is not recent in origin, its value does not appear to have been adequately stressed. The innocent surprise which a roentgen therapist elicits in a not inconsiderable number of colleagues when he advances his just claims probably has its origin in the fact that surgical texts and many surgeons have little or nothing to say as to its employment in these painful and dangerous lesions. For this reason I am prompted to reopen and, if possible, add to this chapter in the book of therapeutic knowledge.

The first report of radiotherapy of carbuncles was made by Coyle[3] in 1906, when he described the early relief of pain in 3 cases so treated.

Dunham[5] successfully treated 67 cases, and in 1916 reported relief from pain and general improvement in the patient's condition within forty-eight hours following treatment. In most of his cases the carbuncle became very soft, assumed the characteristics of a single abscess and drained through a small opening with consequent slight scar formation. He was therefore probably justified in his conclusion that nothing in all roentgen therapy gives such satisfactory results.

The following year Ross[19] treated an extensive carbuncle of the face successfully and in 1923 Lewis[14] reported his experiences with 16 cases, only 2 of which required any operation. It is worth noting that patients familiar with other methods much preferred roentgen therapy.

In 1924, Hodges[11] reported in some detail his experience in a number of cases which he subjected to roentgen irradiation. Nine of them presented large ulcerating carbuncles, and one of them, a patient of sixty-three, was dangerously ill as a result of extensive involvement of the face. The lesion, which extended from the left frontoparietal region to the left clavicle and from the nose to the ear, was of two weeks' duration. There had been only slight watery discharge, the temperature was 103.2° F. and morphine had been required for control of pain. The patient was so weak that roentgen therapy was applied only upon the insistence of a surgeon who had previously responded well to such an application. There was great relief of pain twelve hours after treatment and within twenty-four hours the lesion was soft and drainage of a large amount of pus was spontaneously established. Five days after treatment he was discharged from the hospital. Almost uniform success was obtained in Hodges' series; he further reported[12] marked improvement in other soft tissue infections. He was able to conclude that:

(1) Every carbuncle should have roentgen therapy as soon as the diagnosis is made.

(2) When softening first occurs a small incision should be made.

(3) The pain is greatly relieved in nearly all cases and entirely relieved in many.

(4) The infection is usually limited and the duration of the disease shortened.

(5) There is very little scarring following this method of treatment and no danger or pain associated with the radiation itself.

(6) Other localized infections of the skin and subcutaneous tissues respond very similarly to the roentgen ray.

(7) Areas of lymphangitis extending for some distance away from the localized lesion usually disappear a few hours after treatment.

Most extensive reports have been made by Heidenhain and Fried[9,10] and by Heidenhain.[8] A great variety of inflammatory conditions were treated and 76 per cent of them required no surgical intervention. They also drew attention to the fact that

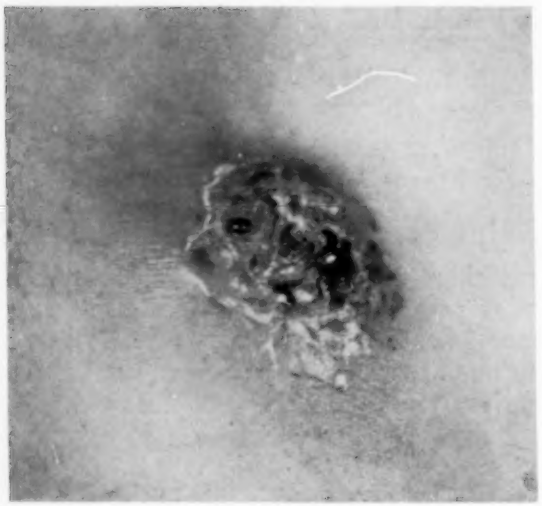

FIG. 1*a*. J. C. L. Before treatment. Large carbuncle on back presenting several areas of ulceration and surrounded by an area of induration. Given 415 r.

better results are obtained if the lesion is irradiated before suppuration has occurred.

Pordes,[15,16,17,18] Black and Black,[1] Holzknecht,[13] Gerber,[7] Fraenkel and Nissnjewitsch,[6] Solomon and Blondeau,[20] Carp,[2] Desjardins,[4] and others, have contributed valuable reports and discussions.

My experience in the treatment of 56 carbuncles in the past three years is not in agreement with the contention of Carp[2] that roentgen therapy without surgery is contraindicated. It is true that the majority of cases have required a small incision to establish drainage, but not infrequently the lesion has opened spontaneously, drained freely and healed normally after roentgen irradiation alone. There is such a remarkable tendency to localization of the process after treatment that the more radical surgical steps are almost never necessary. In this series only one excision has been performed. This patient presented a well-developed huge carbuncle on the back which did not respond to irradiation. An excision was performed, but death from toxemia resulted two weeks later. In no case in which roentgen therapy alone was used has there been a blood stream infection. Yet it must be clearly understood that in every case the patient should be kept under surgical observation so that proper steps can be taken when necessary.

The usual course of events consists in the intensification of pain and elevation of temperature two to three hours after the treatment. This is followed by marked relief of pain within a few hours; the induration disappears, and in twenty-four to forty-eight hours the lesion appears to be sharply localized, drains through a single opening and is accompanied by general subjective improvement. The acute inflammatory phase of the lesion has usually entirely subsided in about two weeks and minimum scar tissue formation ensues, as the possibility of keloid formation is considerably reduced (Fig. 1).

The earlier cases in this series usually had an initial administration of about 300 to 415 r, to be followed in a day or two with an additional 100 to 150 r if proper reaction had not been obtained. It was felt that the almost malignantly inflammatory character of many carbuncles justified a radical radiotherapeutic approach. More recently initial dosages of 200 to 250 r have been used with a success at least equal to that obtained with a larger dosage; additional doses are frequently not neces-

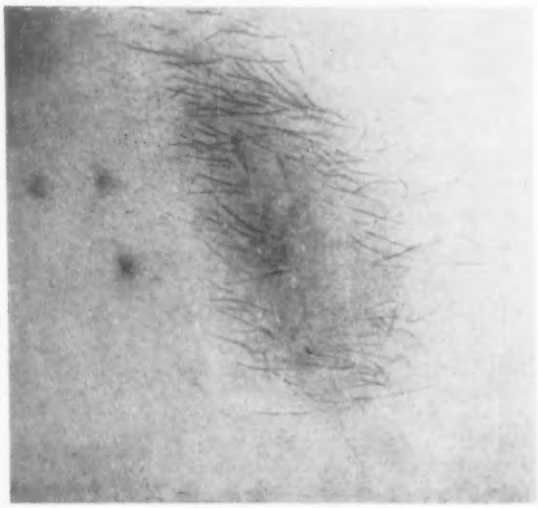

FIG. 1*b*. J. C. L. Two months following irradiation. Note small amount of scar tissue and return of hair at site of lesion.

sary. This is in substantiation of the enthusiasm for smaller doses which has been encountered in the literature. Heidenhain and Fried recommend 10 to 20 per cent H.E.D., as do Holzknecht, Pordes and others. Hodges, in a recent personal communication, states that he often uses 150 r of unfiltered radiation at 80 to 85 kv. The majority of radiotherapists rarely use more than 300 r. We have used effective wave lengths of 0.28 to 0.22 Å (127–150 kv. with 0 to 3 mm. Al). Less filtration and penetration are used for superfical lesions and those which are near mucocutaneous areas. On the other hand deep-seated and advanced lesions require more filtration and greater dosage. Each case is an individual problem and must be solved accordingly. Hot compresses should be continued after irradiation, incision and carbolization being performed if and when pointing occurs. The initial dose should be given during the period of mobilization of leucocytes in the inflamed area, that is, before suppuration has occurred. There is indeed much evidence that early treatment may abort severe infections. For example, I treated a patient who had had a furuncle, of four days' duration, in his nose with beginning widespread inflammation of the right cheek and eye which was much improved within two days following treatment and was well four days later; a cellulitis of the right cheek of one day's duration seems to have been limited considerably by such therapy, the patient's temperature dropping a few hours later and complete healing occurring in two more days; an acute lymphadenitis of the left cervical region of three days' duration was very favorably influenced within two days following treatment. Of course, we have no proof as to what would have happened had roentgen therapy not been given, but the enthusiasm of the surgeons attending these patients leads one to believe they expected a much less rapid recovery.

What appears to be a simple boil on first examination may become a carbuncle a few days later as the result of subcutaneous extension of the inflammatory process. For this reason the patient should have irradiation upon his first visit to the surgeon in order to aid in effecting localization of the lesion. There is no evidence that early attack is injurious; on the other hand, it may do much good.

It is not understood why irradiation is not used much more frequently in view of its positive value. As pointed out by Desjardins, perhaps skepticism has been aroused because of the very multiplicity of lesions in which favorable results have been reported, or possibly a fear of its use originating from the skin or systemic reactions which may occur in prolonged and intensive treatment of malignancy may militate against its use. It seems even more likely that the general medical profession is not fully cognizant of what may be expected by the use of such a therapeutic medium. To those who fear reactions it is worth pointing out that a thoroughly safe margin is allowed in all cases of carbuncle; in none of this series has there been any roentgen sickness.

The mechanism of production of these changes within inflammatory areas has not been definitely ascertained, but the evidence strongly points to lymphocytic destruction as a probable factor in the early defense reaction. It is common knowledge that lymphocytes are exceedingly radiosensitive, degenerative changes having been noted within fifteen minutes following irradiation (Warthin[21]). Therefore, there can be no doubt that marked destruction of lymphocytes must occur in inflammatory processes so treated. Here the rationale of therapy is brought into question, as the mobilization of leucocytes in an inflamed area constitutes a defense mechanism. The question naturally arises, "Why break down this resistance by destroying the cells upon which it depends?" If we assume that these cells contain bactericidal agents we are equally at liberty to assume that destruction of these cells liberates these antibodies and makes them more readily available. For this reason, it

seems, the irradiation should be given in the stage of leucocytic infiltration. Although this attractive and plausible theory so ably advanced by Desjardins, appears to rest on a firm basis, it is not conclusive. After all, most of the infiltrating leucocytes in acute purulent infections are polymorphonuclear neutrophiles, a fact which suggests that lymphocytic destruction, in itself, is not the chief factor involved. Furthermore, we have meager information as to the effect of the roentgen ray upon bacteria in vivo, although in vitro it has been found to be practically nil. The interplay of some yet undetermined biochemical forces in an inflamed area may well be considerably influenced by such irradiation. Regardless of the explanation, the fact remains that inflammatory processes are remarkably benefited; in some cases in which noticeable benefit does not occur there is no evidence of a harmful reaction, especially where smaller doses of radiation are employed.

CONCLUSIONS

The great value of roentgen therapy of carbuncles does not appear to have been adequately stressed. My experience substantiates other enthusiastic reports in the literature. Treatment should be given as early as possible. Although small doses are usually as effective as larger ones of 300 to 400 r, the penetration, filtration and total dose must vary with the location, extent and duration of the lesion. In none of the reports in the literature is the dosage described in terms of roentgens. This should be done in the future in order that there may be some standardization of technique in a field in which roentgen therapy plays one of its most brilliant rôles.

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Vol. 33, No. 1

PRELIMINARY STUDY OF THE EFFECT OF ARTIFICIAL FEVER UPON HOPELESS TUMOR CASES*

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THE thought that fever may have a destructive influence upon malignant disease has occurred to many, but until a simple, safe method for producing a febrile reaction in the body was available,[1] it was not feasible to investigate the effects of this type of therapeutic procedure. I would like to review briefly some of the interesting and rather suggestive results obtained by my colleagues and myself in the last two and a half years of study of this problem.

The problem naturally divides itself into three major parts: (*a*) a study of the effect of febrile temperatures upon animal tumors in vitro and in vivo, (*b*) a study of the temperature gradients in animal tumors during local and general heating, and (*c*) a study of the effects of prolonged and maintained generalized fever (artificially produced) in advanced hopeless tumor cases with widespread metastases.

The manifold difficulties in obtaining clear-cut and conclusive results in any problem having to do with tumors makes it impossible and unsafe to draw any final conclusions from the not inconsiderable data which we have obtained, and it should be emphasized that the data presented should be considered as suggestive only. The complexity of factors involved makes it impossible for any one group to study all phases of this problem, and it is hoped that the data presented may stimulate others to become interested in the effect of febrile temperatures, or a combination of febrile temperatures and irradiation, upon malignant disease.

At this time only a summary of portions of the research program can be given, and the data supporting these assumptions will be published in detail elsewhere. The first attack upon the general problem entails a study of the effect of febrile temperatures upon transplantable tumors of animals, both in vitro and in vivo (with J. Jares). The exposure of slices of tumor tissue with the proper precautions to temperatures of 41.5 and 42° C. in water baths for definite periods of time has convinced us that there is a definite lethal time-temperature relationship much like that found for the gonococcus[2] and the *Treponema pallidum*.[3] This varies with the type of tumor and species of animal involved. In vitro this seems to be about twelve hours at 41.5° C. for the mouse sarcoma No. 180 and the rat carcinosarcoma No. 256. It is about five hours less at 42° C. The Brown-Pearce rabbit epithelioma seems to be killed regularly in fifteen hours at 42° C. Tumor slices exposed for these periods to these temperatures fail to "take" on inoculation.

The next step, that of exposure of the tumors in vivo to such a temperature for such a length of time, is still unsolved because of the failure of the animal host to endure the long febrile period necessary. This is essentially a study of method. Various combinations of local and general treatments by carbon filament bulbs, immersion in part or in toto in baths, local and general high frequency treatment (30 and 100 meter wave lengths) have been tried with evidence of various degrees of destruction of the tumor mass, but with as yet no convincing "cure" of a tumor if all other complicating factors are eliminated, i.e., infection and spontaneous remission, etc. It is fair to say that we have not been able, as yet, to administer to an experimental tumor-bearing animal a fever of the length indicated by the thermal death time as determined in vitro.

The data (gross and histological) from the in vivo experiments bear out, however,

* From the Division of Radiology, Department of Medicine of the University of Rochester School of Medicine and Dentistry and Strong Memorial Hospital, Rochester, N.Y. Read before the American Congress of Radiology, Chicago, Ill., Sept. 25–30, 1933.

the suggestion from the in vitro work that high febrile temperatures of some duration do cause destruction of actively growing, virulent, transplantable animal tumor cells.

In these experiments the temperature of the tumor mass in the animal was kept constantly under observation and control by means of thermocouples inserted in the tumor during the treatment procedures, tribution of heat gradients in the tumor mass during the normal and febrile status, a study was made by means of thermocouples of the variations in temperature of various parts of spontaneous and transplanted tumors in animals under different experimental conditions. These are best illustrated by Figures 1 and 2.

Figure 1 illustrates typical measure-

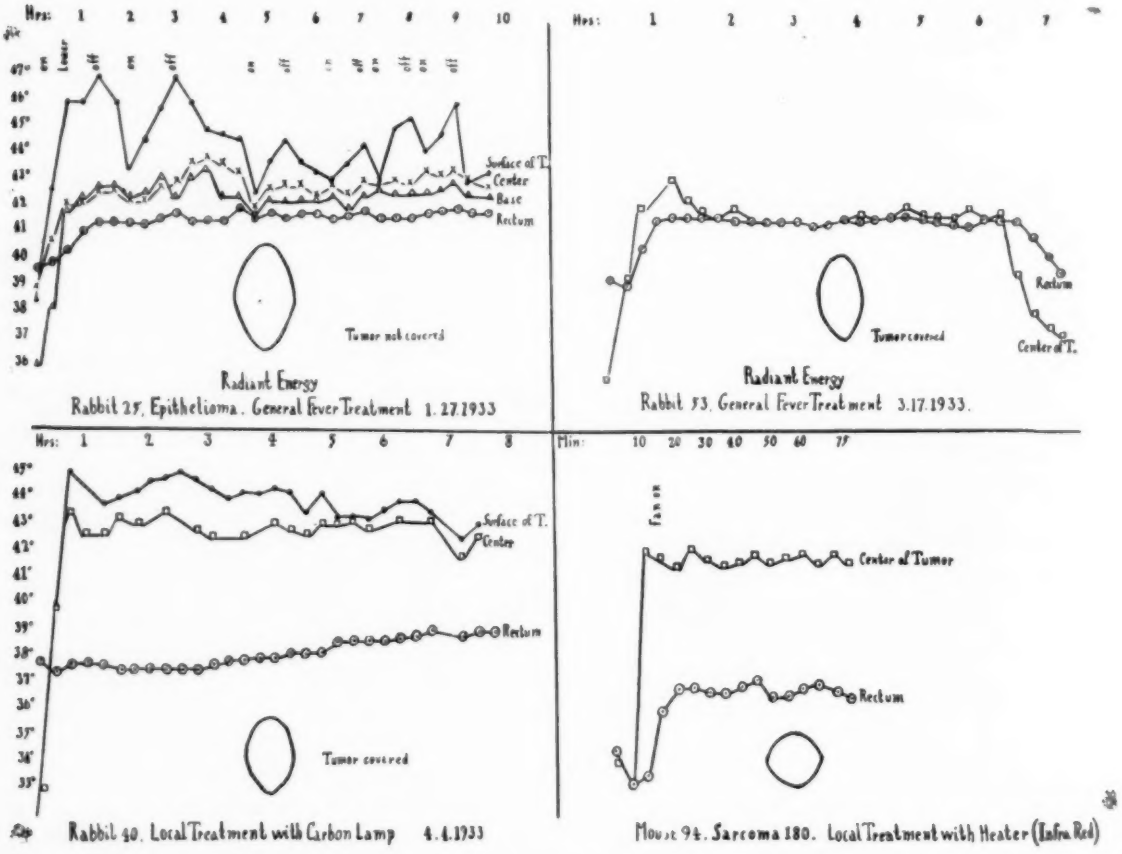

Hrs: 1 2 3 4 5 6 7 8 9 10
Surface of T.
Center
Base
Rectum
Tumor not covered
Radiant Energy
Rabbit 25. Epithelioma. General Fever Treatment 1.27.1933
Hrs: 1 2 3 4 5 6 7
Rectum
Tumor covered
Center of T.
Radiant Energy
Rabbit 53. General Fever Treatment 3.17.1933.
Hrs: 1 2 3 4 5 6 7 8
Surface of T.
Center
Rectum
Tumor covered
Rabbit 40. Local Treatment with Carbon Lamp 4.4.1933
Min: 10 20 30 40 50 60 75
Fan on
Center of Tumor
Rectum
Mouse 94. Sarcoma 180. Local Treatment with Heater (Infra Red)

FIG. 1. The upper left hand chart shows the temperature gradients in a rabbit tumor in the testis and their relation to the rectal temperature. The radiant energy (carbon filament lamp in the top of a cabinet over the rabbit) of course is most intense in the superficial regions. Tumor 3×5 cm.

The upper right hand chart shows how, by careful adjustments of the energy, the temperature of the center of the tumor may be kept near the rectal temperature during the treatment. Note that the tumor is colder than the rectal temperature before and after treatment, and the rapid changes that occur with the application and removal of the radiant energy. Tumor 2.5×3.5 cm.

The lower two charts show the effect of local irradiation of a tumor in the testis of a rabbit (2.5×3.3 cm.), and the flank of a mouse (2.0 ×2.5 cm.), with radiant energy, the 'rectal temperature remaining relatively unaffected.

except in the case of the high frequency treatments where the use of such instruments is not feasible.

In order to obtain some idea of the dis- ments made upon three rabbits with epithelioma of the testis (transplantable) and one mouse with sarcoma No. 180 in the flank (in collaboration with J. Jares).

There are several points of interest. The tumor in the testis is always several degrees colder than the rectal temperature, probably because the testis itself is colder than the rectum and the blood supply to the tumor is restricted. In the upper two charts the animal is exposed to radiant energy (carbon filament bulbs) in a cabinet. In the left hand chart the testis (and tumor) is not shielded and receives direct irradiation. The surface of the tumor (beneath the scrotum) receives a great deal of energy, faster than the blood supply can remove it, and consequently rises in temperature to very high levels, with the production of a heat erythema and blister. The heat is able to penetrate quite well past the capillary bed into the center and base of the tumor, so that the whole tumor mass is elevated above rectal temperature throughout the treatment. The ellipsoid figure represents the actual size of the tumor (3 x 5 cm.).

In the upper right hand chart the animal is irradiated in the same manner except that the testis (and tumor) is shielded from direct irradiation after the first one and a quarter hours and is warmed only by the circulating blood as the general body temperature is elevated. When the shielding is perfect, the center of the tumor has the same temperature as the rectum. The variations are due to displacement of the shield through movement of the animal. Note how rapidly the tumor heats up and cools down in contrast to the changes in the rectal temperature. This is due to its exposed position and poor insulation.

In the lower left hand chart the tumor is treated by means of radiation from a 200 watt, carbon filament lamp. The testis and tumor are covered with thin cloth to diffuse and reduce the intensity of radiation somewhat. Note the ease with which the depth of the tumor can be elevated to between 42 and 43° C. for seven hours by means of local exposure. There is a gradient of from 1 to 2° between the surface of the tumor and the center. It is suggested that this is due to the cooling effect of the circulating blood, although there are probably other reasons as well. The mass of tissue heated is so small, in comparison to the body weight, that the rectal temperature rises only very slowly throughout the treatment period.

The lower right hand chart shows the maintenance of a similarly high temperature in the center of the tumor on the flank of a mouse by means of local irradiation with an infra-red heater. The rectal temperature was affected at first, but was established in equilibrium at 37° C. throughout the hour of treatment. These charts are representative of the findings in numerous experiments with transplantable tumors in rabbits, rats, and mice, and several spontaneous tumors in dogs.

Through the cooperation of one of our patients afflicted with a huge, ulcerated, cauliflower tumor mass (neurogenic sarcoma), it was possible (with E. Lehman and F. W. Bishop) to measure to some extent the local heat gradients in the tumor mass during local heating by means of a carbon filament lamp and reflector over a period of hours. Sterile needle thermocouples were inserted to different depths in the solid-growing part of the tumor not covered by skin. The observations are shown in Figure 2. As was to be expected, the more superficial parts are heated most. It is of interest to note the high elevation of temperature at a depth of 3 cm. (40.5 to to 41.8° C.), with only enough on the surface (2 mm.) to cause a mild erythema on the skin margin nearby. The rapid fall at the end of irradiation indicates losses due to radiation and the circulating blood.

The above observations, and many others made on dogs and calves (with Boak and Carpenter), indicate that the internal organs, and presumably internal tumors, may be maintained during the general febrile state at temperatures close to the rectal temperature. Furthermore, it would seem that the local administration of heat, properly controlled, may have some practical application.

With the above experimental data in

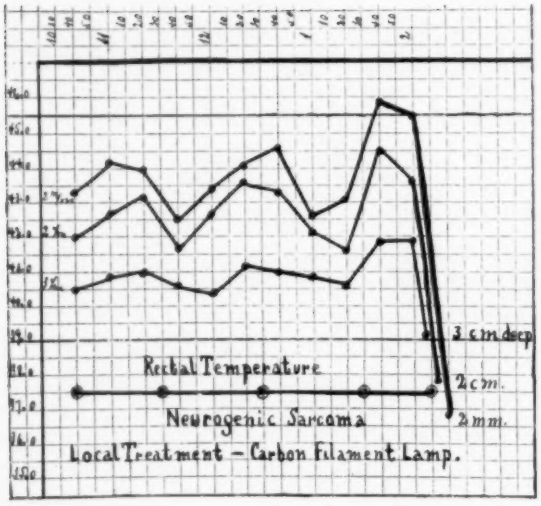
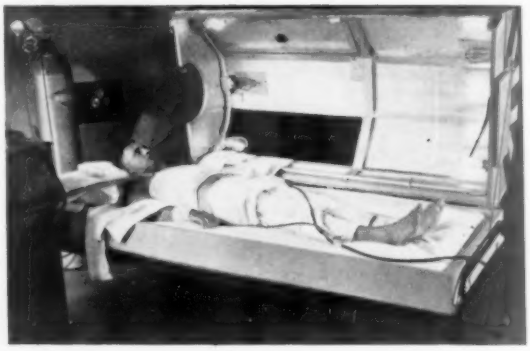
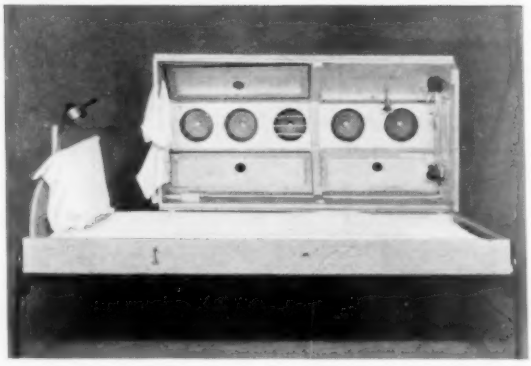


FIG. 2. V. C. Thermocouple measurements in a large ulcerating, cauliflower-like neurogenic sarcoma of the neck. The curves show the extent of penetration of radiant energy of various intensities into a fairly vascular tissue. The absence of skin, of course, was a factor here. This illustrates, however, the possibility of elevating the temperature of tissues at a fair depth (2 cm.) to quite high levels without damaging the surface too much. The sharp fall at the end of the three and a half hours is due to cooling from losses due to irradiation, and to the circulating blood. Although this caused considerable shrinkage of the superficial portion of the tumor, it is not a practical method of therapy at the present time.

mind, there is some justification for a trial of artificial fever therapy in human malignant disease. From March, 1931, to May, 1932, the method used (elevation of temperature by diathermy) has been described elsewhere[1] (Fig. 3). From May, 1932, up to the present, radiant energy (1,040 watts) (Fig. 1) has been used for the entire treatment. The only other change in the method has been in the use of a large fan to cool the patient down instead of the ice water enema previously reported. The elevation and maintenance of the rectal temperature to the highest safe level (41.5° C.) is much simplified by the use of radiant energy.

Thirty-two cases of hopeless malignant disease, with widespread metastases, have been treated. These cases have been referred to us by the various general services or from our own Tumor Clinic (Dr. Ramsey and Dr. Stabins). All were thoroughly studied clinically before treat-





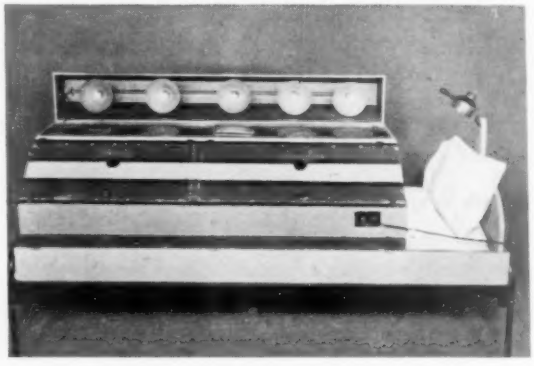
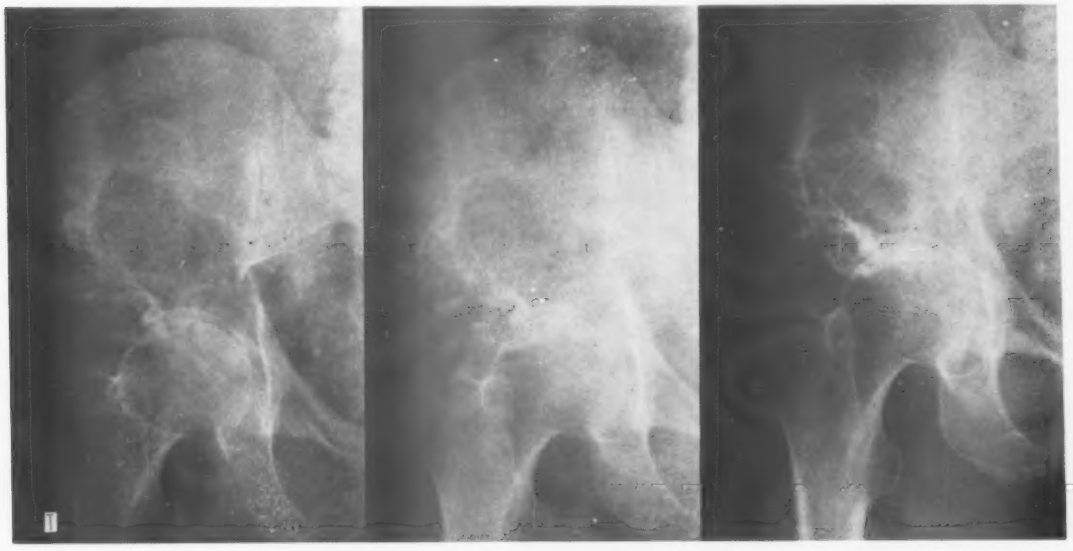


FIG. 3. The upper photograph shows the cabinet used with the "diathermy method"[1], the diathermy current being used only to elevate the patient's temperature and the lights in the cabinet to maintain it. The middle photograph shows the cabinet modified for the "radiant energy method," the five 200 watt carbon filament bulbs supplying the energy both to elevate and maintain the patient's temperature. The lower photograph shows the cabinet closed and the light panel open to illustrate the mounting of the bulbs and reflectors, and the doors in the side for manipulation of the blood pressure, stethoscope, etc.

ment, and the diagnosis verified by biopsy, exploratory operation, or autopsy, except 2 cases which had all of the stigmata of malignant disease. Eighteen cases had received intensive irradiation (deep therapy and radium packs) without result because of the appearance of widespread metastases. Fourteen cases had received no treatment and were too far advanced to justify anything but palliative irradiation. Four of these received no treatment after the fever treatment (2 advanced cases of melanotic sarcoma, 1 lymphosarcoma with generalized adenopathy, and 1 case of hypernephroma without clinical evidence of recurrence after the fever treatment). All of the rest (except these last 4 cases) received either palliative deep therapy a month or more after the fever treatment as return of symptoms indicated, or immediate irradiation after the fever treatment to test the combined effects of the two.

In all of the cases but 3, after the fever treatment there was immediate improvement in the general condition, lasting various periods of time (one to six months), with gain in weight and strength, shrinkage of tumor masses of various amounts and duration. Evidence of return of growth of the tumor process in all of the patients occurred at various intervals and rates. A review of these cases is difficult to correlate because of the variables in each case. Any prognosis is subject to error, yet at the time of the fever treatment it was the clinical opinion of those concerned that because of the rapid growths of the tumors and the condition of the patient the probable length of life was very much restricted (one to three months).



A B C

FIG. 4. F. G. Multiple myeloma, showing the increase in calcium deposit after fever therapy. A, before treatment; B, one month after five hours of fever at 41.5°C.; C, one year later. B shows considerable bridging and increased width and density of the bony trabeculation in the periphery of the lesion. Some deep therapy was given just before the last roentgenogram (C) was taken, and part of the change here is probably due to that, although the dosage was low and not sufficient to cause this amount of repair upon the average case of this type.

A survey of the following brief summary seems to indicate in most of the cases an increase in the expected length of life, when the type of tumor and the stage of disease are taken into consideration.

All of the cases illustrate points of great interest, but only a few of the most striking details may be given at this time. The

Marked Improvement (Marked shrinkage of tumor with very slow recurrence)		
Hypernephroma (Large subcutaneous masses and brain metastasis)	10 months	Clinical disappearance of tumor without other treatment than fever
Multiple myeloma	11 months +	Recalcification started (see Fig. 4)
	7 months +	Recalcification started
Endothelioma bone marrow	23 months	Recalcification started (see Fig. 5)
Cancer of the rectum	12 months −	
(With liver metastasis)	13 months	
	6 months	
Meduloblastoma	11 months	
(With spinal metastasis)	8 months	
	6 months +	
Moderate Improvement (Shrinkage of tumor with slow return)		
Neurogenic sarcoma	8 months	
Osteogenic sarcoma	8 months	(See Fig. 6)
	9 months	
Melanotic sarcoma	5 months	Massive cardiac invasion (No other treatment before or after fever treatment)
Cancer of the breast	2 months	Cerebral hemorrhage? (No other treatment before or after fever treatment)
	10 months +	(See Fig. 7)
Slight Improvement (Marked shrinkage of tumor with rapid recurrence)		
Embryoma of the ovary	5 months	
Embryoma of the testicle	5 months	
Carcinoma of the thyroid	4 months	
Carcinoma of the lung	4 months	
	4½ months	
	1½ months	
Lymphosarcoma	4 months	No other treatment
No Improvement (Slight shrinkage of tumor but rapid return of growth)		
Cyst adenoma ovary	4 months	No follow-up treatment
	2 months	No follow-up treatment
Cancer of the breast	4 months	
	2 months	
	1 month	
No Effect		
Brain tumor—glioma	1 week	
Hodgkin's disease	4 months	
Died during Fever Treatment		
Cancer of the stomach (in extremis)		

+ Patient still living

effects noted in the variety of tumors treated, even though the number in any one group is small, seem to indicate no special sensitivity in accordance with any general classification into major types.

The first patient treated seems to have responded best, although no autopsy was granted.

The patient was a man, aged forty-five, admitted September, 1930, for subtemporal decompression. History of removal of hypernephroma in March, 1929 (verified) and gradual onset of central nervous system symptoms of tumor and increased intracranial pressure. Following decompression patient received intensive deep therapy over the skull between October 1 and December 31, 1930, with some improvement. He returned in March, 1931, with hemiparesis and bulging of decompression defect, and multiple large masses under the skin over the back and flanks. Referred by Dr. Van Wagenen for fever treatment. Received three fever treatments (approximately five

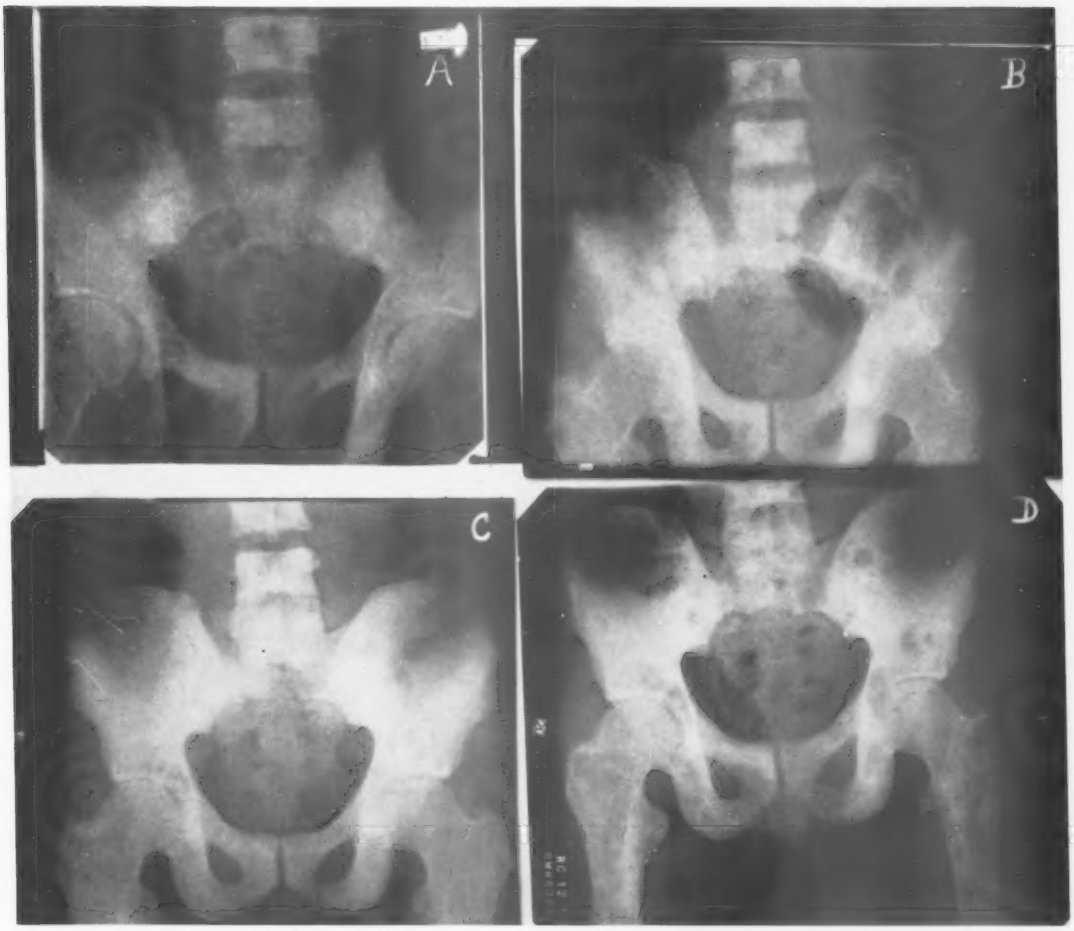


Fig. 5. A. November 4, 1931. Shows the extensive decalcification and localized areas of destruction in the dorsolumbar spine and pelvis before treatment. Biopsy, November 10, 1931. Malignant disease of bone either of metastatic origin or primary—endothelioma of bone marrow—(section seen by many pathologists). Fever treatment November 16, 1931, four hours of fever at 41.5°C. Deep therapy, left lateral pelvis, 500 r on December 20, 1931, and posterior pelvis, 500 r on January 5, 1932 (30 cm. portal).

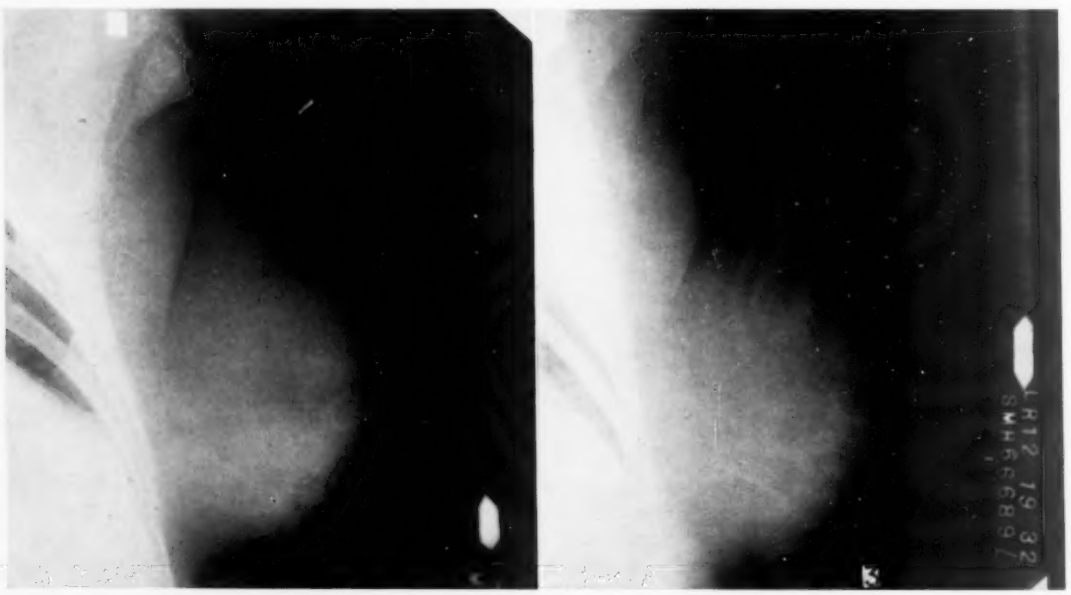
B. February 9, 1932. Shows extensive diffuse recalcification (even in areas not receiving deep therapy). Many areas of destruction still present similar changes in other bones. Deep therapy, 500 r, over posterior pelvic region and left lateral pelvis. General condition, improved, gained 6 pounds in weight. Repetition of this dosage on February 29, April 26, and single doses to pelvis on May 31 and July 12.

C. July 12, 1932. Marked recalcification of pelvis and other bones with areas of localized destruction still present. Skull and ribs show similar changes—progressive gain in weight and progressive development of an anemia. New symptoms of pain in left arm with extensive destruction of cervical vertebra, ribs, clavicles, skull and many other bones even though their density otherwise is high. Second fever treatment October 21, 1932, followed by hemiplegia—gradual recovery from this.

D. December 1, 1932. Shows pelvis five weeks after second fever treatment. There are still areas of bone destruction but the marked increased density of the bones in general is retained. Following this the patient received occasional deep therapy treatments over arm and leg areas for newly developed tumor sites. He gradually went down hill and died in October, 1933, just twenty-three months after his first fever treatment. He received relatively little intensive irradiation chiefly because of his anemia, and it is probable that this patient's life was prolonged somewhat by the additional fever treatment. The most striking effect from the fever treatment seems to be found in the deposition of calcium in the bony skeleton.

A B C

Fig. 6. R. T. Osteogenic sarcoma. Roentgenograms show the change in calcium content of the femur and tumor (soft tissue) substance. A, before treatment; B, three weeks after five hours of fever at 41.5°C., and C, six weeks afterward. C shows considerable calcification in what is apparently the tumor tissue outside of the shaft of the femur. Metastatic areas in the lungs also showed increased density (calcification?) during this time.



A B

Fig. 7. Advanced carcinoma of breast (no biopsy), with axillary and probably chest metastases. Stationary under intensive deep therapy treatment for six months. Following five hours of fever at 41.5°C. the mass in the breast shrank slowly for a month to less than half its previous size (to palpation). A shows the tumor mass before and B after the fever treatment. The mass seems to have lost a great deal of its density in its right upper half (in the reproduction) and to have become much more irregular in general outline and architecture.

hours at 41.5°C. each on March 25, 31, and April 14). He was discharged markedly improved, with shrinkage of the masses and disappearance of the hemiparesis. He was lost sight of for five months, when he returned September 28, 1931, with a story of being ready to return to work when (two weeks previous) he had had a fainting attack and then a mild convulsive seizure. The masses had all disappeared, except for one below the left scapula, which was half of its previous size and felt firm and suggestive of scar tissue (?). Aside from some personality change and the disappearance of the masses, the patient showed little other change since he was discharged five months previously. He was given a fourth five hour fever treatment at 41.5°C. on September 29, and again did not return for observation. His wife reported in January, 1932, that the patient had become gradually worse and finally bedridden for three months, lost weight rapidly, had nasal hemorrhages, and became partially paralyzed and then completely paralyzed, and died on January 27, 1932, ten months after his first fever treatment and two years and ten months after his first operation. The wife stated that the masses did not return on his back or flanks, and that the one still present when he was last examined had not changed in size. Autopsy was refused.

In this case the rapid recurrence of the central nervous system symptoms and the appearance of subcutaneous masses in the interval of three months after intensive irradiation suggests the rapid growth of the tumor in the brain in spite of therapy, and also that there was little residual effect from the therapy at the time of the fever treatments. This would suggest that the fever treatments alone were responsible for the disappearance of the subcutaneous tumor masses and perhaps shrinkage of the brain metastasis as well. Death may have been due to recurrence of tumor growth in the brain, or changes due to collapse and scarring of tumor area accompanied by hemorrhages or other factors.

The case which gave us the most information was that of a young woman aged twenty-two with an advanced, rapidly growing embryoma of the ovary. She was extremely cooperative and courageous, enabling us to learn that a much longer febrile period (twenty-one to twenty-four hours) (Fig. 8) was possible, and granted us permission for biopsy before and after fever treatments.

B.W. October, 1930, operation Watts Hospital, N.C.; diagnosis, carcinoma right ovary. No postoperative treatment.

Admitted Strong Memorial Hospital, September 28, 1932. Eleven days previously she had noted tender masses in left axilla and left side of neck—steady increase in size. Epigastric mass and inguinal masses developed while the patient was in the hospital.

October 1, 1932: Biopsy—reported embryoma of ovary by Dr. Hawkins (Fig. 9).

October 7, 1932: 250 r (200 kv., 0.5 mm. Cu, 1 mm. Al filter) applied to left side of neck over mass. In view of widespread metastases, further irradiation was discontinued, and after consultation with Dr. McCann, fever treatment instituted.

October 12, 1932: Six hours of fever at 41.5°C.

October 12: Mass on left side of neck previously about 5×4×3 cm. no longer visible but palpable as 2×3×2 cm. Other masses in left axilla, epigastrium and groin also reduced in size.

October 15, 1932: Discharged to local medical doctor.

October 20, 1932: Mass in left supraclavicular region and base of neck now difficult to define and is separated into six hard, movable, discrete masses 2–3 cm. in diameter.

October 21—November 14, 1932: All of the masses previously noted have gradually become palpable and have steadily increased in size. Patient steadily going downhill.

November 15, 1932: Fever therapy seven hours at 41.5°C. Patient in such poor condition that she was unable to stand more. Masses decreased slowly and steadily in size, and then increased slightly again.

November 22, 1932: Fever therapy thirteen hours at 41.5°C. Improved in general condition. Masses shrinking slowly and becoming fluctuant.

November 26, 1932: Biopsy of mass in left supraclavicular region (Fig. 11)—soft, cheesy, necrotic material within lymph node capsule. Patient steadily improved in strength; masses decreased a little in size and have become

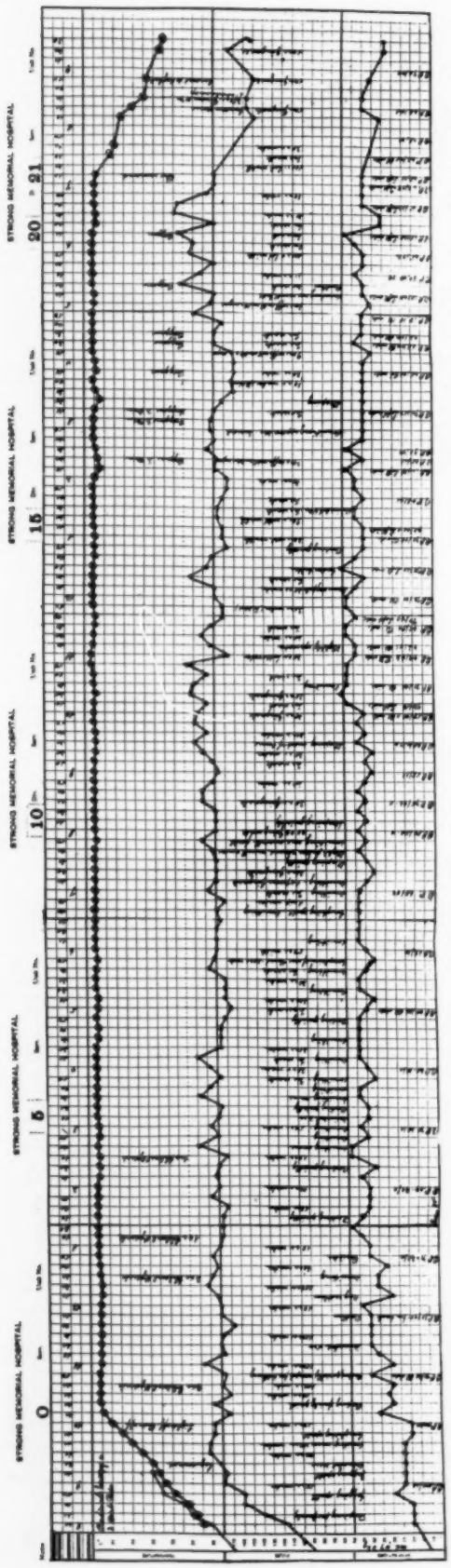


FIG. 8. The temperature, pulse and respiration chart of Case B.W., who received a twenty-one hour treatment (at 41.5°C. rectal), showing the uniform level of the rectal temperature record. Radiant energy method.

slightly rubbery and seemingly fluctuant. Improvement continued.

December 12–15, 1932: Increase in masses and pain. Lung metastases increasing in size also.

December 15–16, 1932: Fever therapy for twenty-one hours at 41.5°C. (see Fig. 8), followed by two cross-fire deep roentgen treatments on day after fever treatment; i.e., 250 r (200 kv., 0.5 mm. Cu, 1 mm. Al filter) over posterior neck and axilla and anterior neck and axilla, 25 cm. portal—included masses in left supraclavicular region and upper one-third of lung fields, which contain metastases. This was to test the combined effects of fever therapy and irradiation. Patient's skin in bad condition and unable to stand further irradiation.

December 24, 1932: Discharged home, with masses slightly smaller.

December 29, 1932: Re-admitted for biopsy. Masses essentially unchanged.

January 1, 1933: 350 r over whole anterior chest wall and left side of neck.

January 4, 1933: Masses growing rapidly and have almost doubled in size during the last few days.

January 6–7, 1933: Three deep roentgen treatments over lung fields and abdominal mass, followed by some improvement and slight shrinkage of the masses. Skin pigmented and scaly.

January 10, 1933: Discharged.

January 19, 1933: Re-admitted. Had improved for a while. Now going downhill rapidly —leucopenia.

January 20, 1933: Fever therapy five hours at 41–41.5°C., followed immediately by 350 r of deep therapy over anterior chest, 25 cm. field.

January 21, 1933: Deep therapy over abdominal mass and pelvis. Discharged home, where she improved for a while but returned with masses increasing in size again.

February 2, 1933: Deep therapy, 180 r posterior chest. Re-admitted. Skin markedly pigmented and tender. From now on the patient failed rapidly. Leucopenia prevented extensive irradiation or other treatment.

March 16, 1933: Exitus.

October 1, 1932: First biopsy—nodular, soft mass (3×2×1.5 cm.), cut surface smooth; white, moist, soft and doughy. Histological study (Figs. 9 and 10)—section of lymph node whose normal architecture is almost entirely replaced by large polyhedral, undifferentiated cells in no particular arrangement—very little stroma—numerous mitotic figures—consistent with diagnosis of embryoma of ovary.

November 26, 1932: Second biopsy—three days following thirteen hours of fever treatment at 41.5°C. Soft yellowish, granular tissue surrounded by a rim of lymphoid tissue. Approximately two-thirds of the tumor cells show an irregular, darkly stained nucleus and are apparently degenerating. Many areas containing necrotic hyalin material (degenerated tumor cells) (Figs. 11 and 12).

January 3, 1933: Third biopsy—eighteen days after the twenty-one hour fever and seventeen days after 500 r, and two days after 700 r. Histological study shows irregular masses of fairly large, clear cells. Most of the cells show rather marked degenerative changes—nuclear degeneration, fragmentation and indistinct cell outlines—considerable fibrosis surrounding the tumor cell masses—one small area of tumor cells has the appearance of being undisturbed, i.e., probably actively growing.

Autopsy (Dr. R. Knutti): Lungs packed with spherical masses of pearly white, solid tumor except in upper one-third of lungs, where there are only a few, much smaller masses, and the only good uninvolved lung parenchyma and alveoli. Abdomen contains several large tumor masses. Left supraclavicular area and left axilla contain sclerosed, matted masses of tumor tissue, some brownish in color, some pearly white, and some areas almost cyst-like in character.

It is of interest that the upper portion of the lung fields which had received deep therapy after the twenty-one hour fever (at 41.5°C.) seemed to have less tumor than other parts of the lung. The chest films seem to indicate that some of the masses in the apex of the lungs disappeared after the combined twenty-one hour

Fig. 9. B. W. Biopsy of a lymph node from the left supraclavicular region before treatment, showing the solid cellular masses with relatively little stroma—October 1, 1932.

Fig. 10. B. W. High power photomicrograph, edge of tumor, showing the cell masses and stroma before treatment. Embryoma (ovary).

fever and deep therapy, while the masses treated by fever alone may have shrunken, then returned rapidly and increased in size.

The second biopsy, made three days after the third fever treatment (thirteen hours), seems to show, and in that corresponds to the findings in treated animal tumors, a destruction (degeneration) of a large number of tumor cells with only here and there small masses of what appear to be viable and growing cells. These seem to surround or be near blood vessels as their most outstanding characteristic.

It was hoped that intensive deep therapy treatment by the fractional method might damage the residual tumor cells, but the skin reacted (scaling and pigmentation) to 250 r (one-half s.e.d.) after fever therapy, and also the patient developed a persistent leucopenia (1,800–2,500 white blood cells per cu. mm.) which prevented any building up of dosage when it might have been most effective.

In this last case, as well as in several others, we seemed to obtain a definite increase in destructive effect by a combination of fever treatment and deep therapy. Several cases were treated with fever shortly after intensive deep therapy without any intensification of the effect expected from fever therapy alone. There was considerable damage from abrasion of the recently irradiated skin, which had

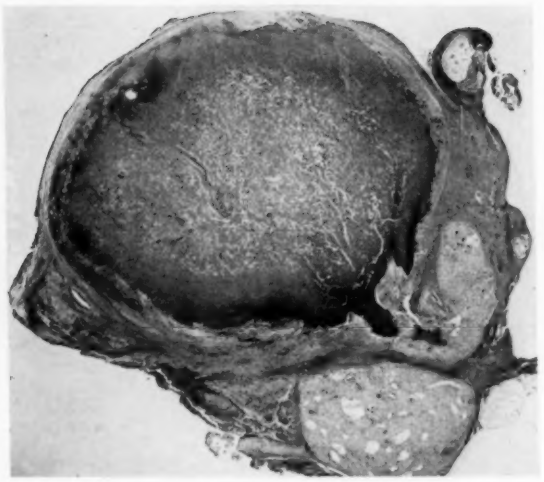


Fig. 11. B. W. Biopsy of a lymph node in the left supraclavicular region taken November 26, 1932, three days following thirteen hours of fever at 41.5°C. Note the degeneration and necrosis of almost the whole content of the lymph node. This material was semifluid.

become softened by sweat during the fever. These areas healed slowly. The present program entails a study of the combined effects of fever therapy followed by roentgen irradiation upon animal tumors, and time intervals and dosage will have to be worked out most carefully.

CONCLUSIONS

(1) There is in vitro (and some in vivo) experimental evidence suggesting a definite "thermal death time" for *transplantable animal tumors* at high febrile temperatures.

(2) There is a distribution of heat by the circulating blood in the febrile state so that the internal organs and tumors *in animals*, and presumably in humans, reach and can be maintained at any predetermined temperature level. This is usually nearly equal to the rectal temperature.

(3) Upon this basis, 32 hopeless advanced human cases of different types of malignant disease were treated by generalized fever therapy, and a combination of fever therapy at 41.5° C. and deep roentgen therapy.

(4) In cases previously treated by deep roentgen therapy, and in untreated cases, fever therapy seems to have a definite destructive effect upon the tumor cells. The amount of destruction and its duration varies from case to case.

(5) Further work on this aspect of the treatment of malignant disease seems to be warranted in the hope of obtaining an additional aid in the treatment of this malady. *It should be emphasized that no results approaching cure have yet been obtained by this procedure.*

I wish to express my appreciation of the cooperation of the various members of the clinical services, and especially Dr. William S. McCann, Dr. J. J. Morton and Dr. J. Van Wagenen, without whose interest and help this study could not have been made. I wish to thank my collaborators Mr. J. Jares, Jr., Mr. Francis Bishop, Miss E. Lehman and Miss J. Walthers for permission to publish data from the animal work now going on in this laboratory in order to illustrate some of the points brought out in this brief summary.

This work was supported by a grant from the Rockefeller Foundation for Medical Research.

Fig. 12. B. W. High power photomicrograph at the edge of the degenerated necrotic area of Figure 11, showing the necrotic cell substance near a septum and in the lower portion of the reproduction a group of partly degenerating and some apparently viable cells near blood vessels and large sinuses. These tumor cell remnants are relatively few, but are probably responsible for the rapid recurrence of the tumor.

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THE DANGERS OF ROENTGENOSCOPY AND METHODS OF PROTECTION AGAINST THEM

III. THE PROTECTIVE POWER OF THE BARIUM-FILLED STOMACH*

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IN CONNECTION with the estimation of the value of the barium-filled stomach as a "protective device," the technique of palpation must be taken into consideration. It is the practice of members of the staff to approximate the walls of the partially filled stomach by means of deep palpation to such an extent that all of the barium but that trace remaining between the rugae is displaced up, then down, and then laterally, to give the extremely valuable picture of mucosal relief. This procedure exposes the palpating fingers to the roentgen rays without the shielding effect of the barium-filled viscus and, since the anterior abdominal wall is considerably depressed, with less than the previously estimated amount of tissue as a protection. It seemed advisable, therefore, to investigate the risks of deep palpation. To this end a number of patients were taken as they left the screen room after gastric roentgenoscopy into an adjoining room where there is a vertical roentgenoscopic apparatus, identical with the one used in the routine examination. There roentgenoscopy was again carried out, and the outline of the shadow of the barium-filled stomach was drawn with a wax pencil on a piece of washed film base. The patients thus examined included men and women of all the usual body types; they had either normal stomachs or were suffering from various gastric lesions. In each case the fluorescent screen rested on the anterior abdominal wall. Next, the amount of posterior displacement of the anterior abdominal wall necessary to produce a satisfactory picture of the mucosal relief was estimated. For this purpose a rod supporting a cross arm, so arranged as to slide freely up and down on the rod but always maintain a right angle to it, was used. To the free end of this cross arm a flat piece of wood was attached to correspond to the palpating hand (Fig. 1).

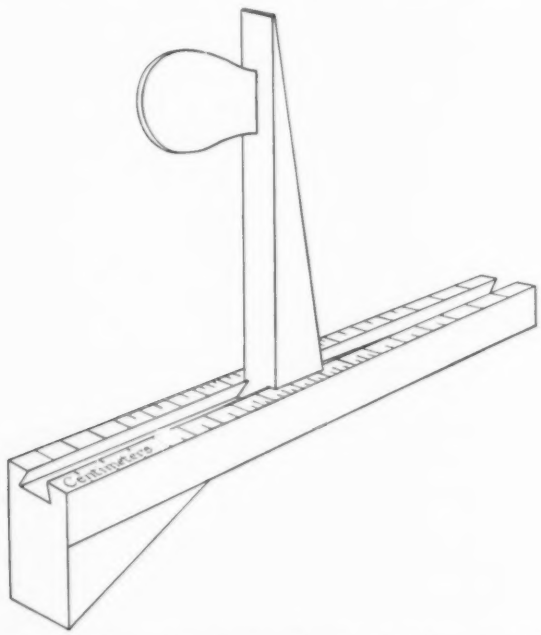

FIG. 1. Measuring device for determining the depression of the anterior abdominal wall coincident with deep palpation for elicitation of mucosal relief.

* Abstract of thesis submitted by Dr. Cilley to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Radiology.

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The device was placed with the rod in contact with, and vertical to, the back board of the roentgenoscope, against which the patient rested his back firmly. The movable arm was arranged so that the palpating device, attached to its free end, was in contact with the abdominal wall; the position of the arm on the rod was noted, and pressure was applied by means of the palpating device, under roentgenoscopic control, until a satisfactory mucosal relief picture was obtained. The resulting position of the movable arm was noted. The difference in positions, measured in centimeters, thus measured directly the distance the anterior abdominal wall had been depressed to bring out the mucosal relief (Fig. 2).

The extreme depression of the anterior abdominal wall required to produce visualization of the mucosal relief in a large, obese man was 8 cm. The minimal compression required in a small, thin woman was 3.5 cm. The majority of the cases required from 4 to 6 cm. of compression and more than half required 5 cm. A large variety of body types, of both men and women, required from 4 to 6 cm. of compression to produce a satisfactory mucosal relief picture. From these observations we chose 5 cm. as the average compression required.

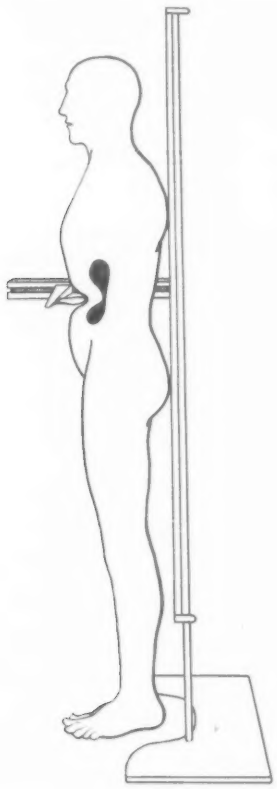

Fig. 2. Measurement of the depression of the anterior abdominal wall necessary for elicitation of mucosal relief.

Fig. 3. Roentgenogram of the model stomach constructed in the 21 cm. phantom.

Superimposing the gastric outlines, we were somewhat surprised, even though the patients had received relatively small, identical amounts (6 oz. or 180 c.c.) of suspension of barium, to find how closely they corresponded in size. There was, of course, considerable variation in shape, which is not of great importance as far as the shielding effect of the stomach on the hand is concerned. From the composite of superimposed outlines a model "stomach," making allowance for magnification, was drawn. This corresponded roughly in shape to a fishhook stomach (Fig. 3).

By consulting Desjardins' charts, it was determined that the average stomach lies 7 cm. from the surface of the anterior abdominal wall. The phantom was accordingly split 8 cm. from one face, forming two blocks 26 cm. square, one 8 cm. in thickness, the other 13 cm. in thickness.

Using the outline selected for the model the wax was hollowed out until a rubber balloon containing 6 ounces of our standard barium meal just filled the outline, with its anterior wall very nearly 7 cm. from the near or anterior surface of the wax. With the phantom rearranged with the "stomach" in it another series of measurements was made with 85 kv., 5 ma., 38 cm. target-skin distance, 0.5 mm. Al+1 cm. plywood, which produces an erythema dose (400 r measured in air) in twelve and a half minutes.

This group of measurements was so designed as to take into account the screening technique of the members of the professional staff. (The principal measurements made may be seen in Figure 4.)

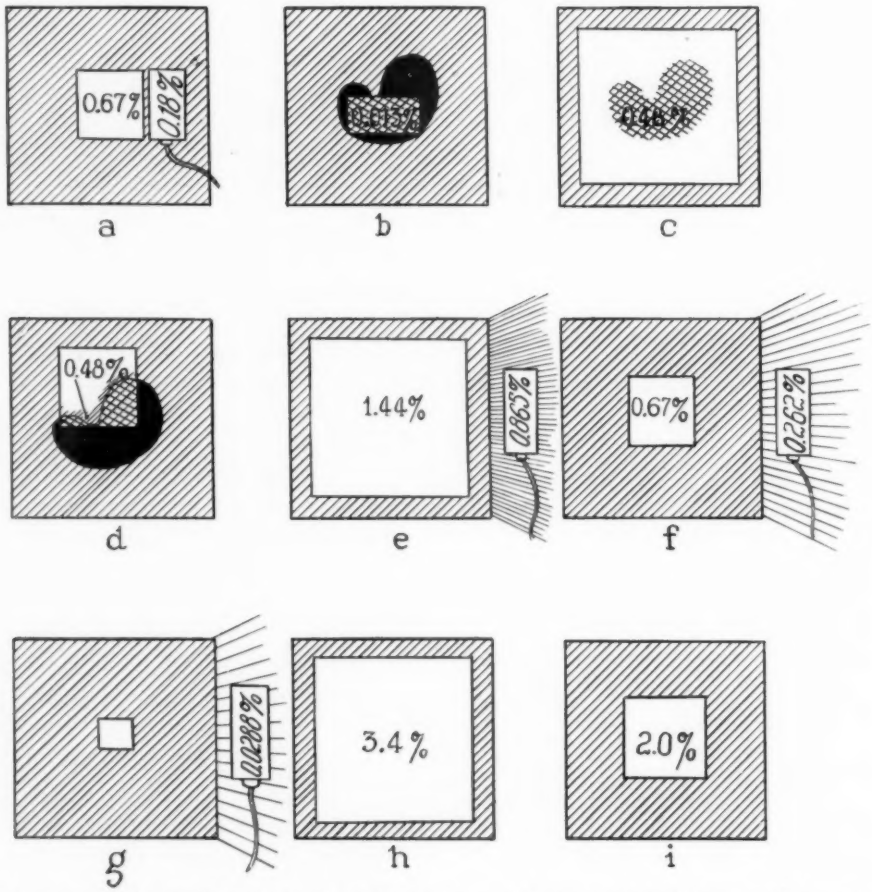

FIG. 4. The relative positions of the ionization chambers, model stomach, and beams of several sizes used in a representative group of measurements about the 21 and 16 cm. phantoms. These measurements were calculated to cover the influences of the main technical factors governing the intensity of the radiation reaching the roentgenoscopist. The percentage of the intensity delivered to the "tube" surface of the phantom reaching the various positions measured on the "abdominal" surface is noted for each position: *a*. Intensity just without the direct beam measured with the 500 c.c. chamber in the position shown. *b*. Intensity measured by the large chamber with the beam hidden by the stomach. *c*. Intensity measured by the 2 c.c. chamber in the shadow of the stomach. The beam used is 20 cm. square. *d*. Intensity measured along the lesser curvature, using the 2 c.c. chamber and a beam 10 cm. square partially behind the stomach. *e*. *f*. *g*. Intensities reaching the 500 c.c. chamber placed at the side of the phantom as altered by changes in the size of the beams used, which are 20 cm. square, 10 cm. square, and 5 cm. square, respectively. *h*. and *i*. Intensities transmitted by the 16 cm. phantom by beams 20 cm. square and 10 cm. square, respectively.

The factors of the kilovoltage, tube current and target phantom distance are constant throughout these measurements.

First the roentgen beam was cut down to such a point as to be completely shielded from view by the "stomach," and the amount of radiation reaching the large ionization chamber placed against the wax over the "stomach" was measured as 0.013 per cent of the initial dose. It should be recalled that these same factors, without barium in the stomach, give a depth dose (through 21 cm. wax) of 0.62 per cent. This means that the intensity is decreased 99.5 per cent by the barium. Next, the 2 c.c. chamber was placed in the center of the shadow of the "stomach" and a 20 cm. beam used. This area was found to receive 0.48 per cent of the intial dose. Next, a 10 cm. square beam, corresponding in size to that used when the lesser curvature is being explored, was placed partly behind and partly above the "stomach," the bright area seen on the screen was thus 10 by 6 by 7 cm., its lowest border being the lesser curvature of the "stomach" (Fig. 5). The 2 c.c. chamber was placed so that it projected into the bright area with somewhat less than half of it in the shadow of the lesser curvature, and the intensity in this area was found to be 0.48 per cent of the intensity on the "patient's" back. As can be seen from these data, the intensity reaching the examiner's hand shielded by the barium-filled stomach depends on the shutter opening he uses and the relative position and size of the beam and the hand in the course of ordinary manipulation.

The measurements given in the foregoing are not applicable to conditions during elicitation of mucosal relief, when, as we have shown, the thickness of the average patient is reduced from 21 cm. to 16 cm., and the fingers are deprived, due to the very nature of the examination, of practically all protection by barium. Therefore, by means of another cut and rebuilding, the thickness of the phantom was reduced to 16 cm., and measurements were made, using a 20 cm. beam, a 10 cm. beam, and a 2 cm. beam. The 2 cm. beam was thought, perhaps, to reproduce the intensity received by the fingers when forcing the barium aside and bringing out the picture of mucosal relief. At this depth, with the 10 cm. beam, 2.0 per cent of the initial beam was let through, and with the 20 cm. beam, 3.4 per cent was let through the wax (Fig. 4). With the 2 cm. beam, however, only 0.8 per cent was let through. From these measurements, it seems safe to assume that, during routine roentgenoscopic procedures, anywhere from 0.013 per cent to 3.4 per cent of the radiation delivered to the back of the patient may reach the operator's hand, depending on the technique he uses. In other words, the operator may, with his hand in contact with the patient's abdomen, through varying the size of the beam and the position of his hand with reference to the stomach, decrease or increase the dose on his hand over a range of more than 260 times, or 26,000 per cent. Assuming that deep palpation to elicit mucosal relief, our most dangerous procedure, is never used, the

Fig. 5. Roentgenogram of the model stomach partially outlined by a beam 10 cm. across.

operator may vary the dosage received conservatively over 110 times, or 11,000 per cent. We may assume that the various procedures, without indulging in deep palpation at all, permit an optional variation in dosage of only 50 times, or 5,000 per cent, to the examiner's hand on the anterior abdominal wall of the patient. Two operators, examining two identical groups of patients, with identical machine settings, and consuming identical amounts of time conducting the examinations, both using beams large enough to be practical, might well change the beam-hand relationships to such an extent that the one might receive a severe skin reaction while the other received but 10 per cent of the erythema dose. Assuming that full advantage is taken of all protection afforded by the barium-filled viscus during the palpatory procedures, the field for speculation about variations in dosage becomes startingly large, and the seemingly notable immunity of members of our staff is more readily understandable.

The possibility of variations in the hand-beam relationship and consequent dosage is infinite. We feel, however, that we have measured enough combinations to allow calculations of this dosage as accurately as is reasonable, considering the tremendous variations required for the examination of each of a number of individual patients. For example, days may go by in which not a patient requires more than a cursory examination of the mucosal relief, requiring perhaps ten seconds. Again, a dozen cases in a single afternoon may present peculiar conformations of rugae, or questionable flecks that necessitate anywhere from fifteen seconds to two minutes' examination by this procedure to make the diagnosis. The consequent dosage may thus vary more than 100 per cent from one day to the next, granting a similar number of cases. Since in the course of a single week the number of patients examined commonly varies from 10 to 35 per afternoon for eight months of the year and from 20 to 70 per afternoon for the remaining four months, with record lows and highs from 8 to more than 100 not extremely rare, infinite possibilities of different exposure of the examiners' hands arise.

SUMMARY

The barium in the stomach during roentgenoscopic examination is an important protective element. Elicitation of the picture of the mucosal relief by deep palpation increases to a marked extent the dose of roentgen rays received by the examiner's hand. Data are presented to show that the emphasis placed by the roentgenoscopists of The Mayo Clinic on the value of the barium-filled stomach, and the smallest possible beam, as protective devices, is justified.

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Thirty-sixth Annual Meeting: Atlantic City, N.J., Sept. 24–27, 1935.

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20th Annual Meeting: Atlantic City, N.J., June 10–11, 1935.

EDITORIAL

ALBERS-SCHÖNBERG'S DISEASE

(MARBLE BONES; OSTEOPETROSIS)

AMONG the rare diseases which are encountered is osteopetrosis[1] or Albers-Schönberg's disease. Albers-Schönberg, a roentgenologist of Hamburg, in 1904 called attention to an unusual condition in which the roentgenographic examination of the skeleton showed preservation of structural contours of the bones with transformation of the medullary canal and spongy portions into compact bone substance and probably increased lime content, giving the bones a marble-like appearance. The changes are usually generalized, although frequently the humeri and bones of the lower arm and those of the lower jaw are less involved than the rest of the skeleton. The most striking changes in increased bone density usually occur in the vertebral bodies, the central part of the pelvis, the base of the skull, the upper third of the femurs and the lower third of the tibias and fibulas.

The relative infrequency of the disease is best indicated by the fact that McCune and Bradley[2] in a recent review of the literature were able to collect only sixty-seven cases, to which they add a case of their own, making a total of sixty-eight. Most of the cases of Albers-Schönberg's disease have been diagnosed as a result of the roentgen examination which was made because of the occurrence of pathological fractures, the bones in these cases exhibiting an unusual fragility so that proportionately insignificant accidents give rise to various fractures, or else the roentgen examination was made because of some puzzling clinical problem.

[1] Karshner, R. G. Osteopetrosis. AM. J. ROENTGENOL. & RAD. THERAPY, 1926, *16*, 405–419. (Extensive bibliography.)

[2] McCune, D. J., and Bradley, C. Osteopetrosis (marble bones) in an infant; review of the literature and report of a case. *Am. J. Dis. Child.*, 1934, *48*, 949–1000. (Extensive bibliography.)

The Albers-Schönberg syndrome is one of a group of combined diseases of bone and of the blood-forming apparatus. The characteristic bone changes are usually associated with an anemia, the origin of which is closely bound up with the etiology of osseous sclerosis. Multiple pathologic fractures are not infrequent, and there may be present hydrocephalus, optic atrophy and enlargement of the liver, the spleen and the lymph nodes throughout the body. The disease shows a striking familial tendency and is occasionally hereditary.

One of the constant and characteristic features of the disease is a generalized increase in the density of the cortex and spongiosa of the bones. "In the spongiosa this increase results from augmentation of the number and thickness of the individual trabeculae. In the cortex the number of lamellae per unit of volume is greater than normal. In both places the increase in osseous tissue is brought about at the expense of the space usually occupied by myeloid tissue, fatty marrow and blood vessels. . . . The architectural pattern resulting from these changes is frequently disorderly and irregular, showing striking qualitative as well as quantitative changes from the structure of normal bone. . . . The disturbances responsible for the sclerosis seem to be located largely in the endosteal and endochondral metabolism of bone. The thickening of the cortex and of the individual trabeculae results from the laying down of both lamellated and nonlamellated bone through the activity of osteoblasts. . . . As the result of factors which are poorly understood, osteoid is sometimes present in an unusually large amount, ordinarily around the edges of the trabec-

ulae. Hypothetically, one of these factors might be an intake or utilization of calcium and phosphorus insufficient to supply the demands of increased production of bone. The osteoid may be an expression of trabecular resorption similar in appearance to that seen in rickets or in osteomalacia."

"Disturbances in endochrondral formation of bone have been demonstrated histologically. . . . These alterations consisted in hypercalcification of the cartilaginous ground-substance and the persistence of foci of calcified cartilage in the zone of newly formed trabeculae. Clublike widening of the ends of the shafts has been demonstrated roentgenographically in so many cases that it constitutes a characteristic feature. The rate of the longitudinal growth of bone is frequently retarded."

"One of the characteristic roentgenographic aspects of the disease is the presence of alternating bands of greater and less density arranged parallel to the epiphyseal line. The explanation of these bands appears to lie in the relative intensity or vigor of the following factors: the rate of longitudinal growth resulting from endochrondral activity; the intensity of the osteoblastic production of bone, and the amount of osteoclastic or trabecular resorption. The bands demonstrate that the disease is relatively intermittent, and that it undergoes fluctuations in intensity, at least as far as the bones are concerned." Curiously enough the periosteum does not, as a rule, participate in the bone changes. The changes in the epiphyses are the same as those exhibited in the shafts of the bones. There is no change in appearance in the centers of ossification, though there may be some delay in the union of the epiphyses to the shaft. The endocrine system, which is usually incriminated as the causative factor in so many bone dyscrasias, has, in most cases in which it has been examined, been found to be normal.

Most of those who have reported upon the quality of the bone have called attention to the fact that it was extraordinarily hard. Pirie[3] in an investigation of this question found that the pieces of bone taken from cases of Albers-Schönberg's disease were more easily penetrated by a drill than was a piece of normal bone and from his experience he suggested the name "chalky bones" rather than "marble bones."

The etiology of Albers-Schönberg's disease is unknown. It has been suggested that the cases grouped under this heading do not represent a distinct clinical entity but are simply a symptom-complex resulting from the operation of various causes and lack of common etiologic factor. McCune and Bradley state that there are probably enough data to suggest that osteopetrosis may be accompanied by some sort of disturbance in the calcium and phosphorus metabolism but the nature of this disturbance, if present, is entirely conjectural. They further conclude that in the face of contradictory anatomic findings with regard to the endocrine system and in the absence of convincing evidence pointing to environmental factors and deficiency, one is forced to the assumption that the fundamental pathologic changes in osteopetrosis lie within the osseous system itself. Blood and bone have the same primordial forerunners. Both arise ultimately from the undifferentiated tissue which has within itself the potentiality of producing either hematogenic or osteogenic tissue. The generally accepted view is that the fundamental defect in Albers-Schönberg's disease consists in a faulty differentiation and development of this primitive substance. This expresses itself in the production of an excessive amount of abnormal osteogenic tissue which proliferates at the expense of, or in the place of, normal blood-forming marrow.

Whether or not the disease is associated in any way with parathyroid disturbance is not clearly shown but it is of interest to note that Péhu and his associates[4] found a

[3] Pirie, A. H. The development of marble bones. Am. J. Roentgenol. & Rad. Therapy, 1930, *24*, 147–153.

[4] Quoted by McCune and Bradley.

parathyroid adenoma in their patient, and there are certain characteristics of the bone changes which have some resemblance to the changes noted in cryolite workers, and the possibility of there being some disturbance in metabolism associated with fluorine has been suggested. Whatever is the etiologic factor, the disease is of interest to roentgenologists and the cases coming under their surveillance should be published in the hope that some new light may be thrown on a rather obscure disease.

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this section solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES*

United States of America

American Roentgen Ray Society
Secretary, Dr. E. P. Pendergrass, University Hospital, Philadelphia, Pa. Annual Meeting: Atlantic City, N. J., Sept. 24–27, 1935.

American College of Radiology
Secretary, Dr. Albert Soiland, 1407 S. Hope St., Los Angeles, Calif. Annual meeting: Atlantic City, N.J., 1935.

Section on Radiology, American Medical Association
Secretary, Dr. J. T. Murphy, 421 Michigan St., Toledo, Ohio. Annual meeting: Atlantic City, N.J., June 10–14, 1935.

Radiological Society of North America
Secretary, Dr. D. S. Childs, 607 Medical Arts Bldg., Syracuse, N.Y. Annual meeting, 1935, to be announced.

Radiological Section, Baltimore Medical Society
Secretary, Dr. W. B. Firor, 1100 N. Charles St., Baltimore. Meets third Tuesday each month, September to May.

Radiological Section, Los Angeles County Medical Society
Secretary, E. N. Liljedahl, Los Angeles, Calif. Meets on the fourth Wednesday of each month at the California Hospital.

Radiological Section, Southern Medical Association
Secretary, Dr. H. J. Walton, 104 W. Madison St., Baltimore, Md. Annual meeting, St. Louis, Mo., Nov. 19–22, 1935.

Brooklyn Roentgen Ray Society
Secretary, Dr. A. L. Voltz, 115 Myrtle Ave., Richmond Hill, N.Y. Meets monthly on first Tuesday, October to April.

Buffalo Radiological Society
Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi, 610 Niagara St., Buffalo, N.Y. Meets second Monday of each month except during summer months, place of meeting selected by the host.

Chicago Roentgen Society
Secretary, Dr. R. G. Willy, 1138 N. Leavitt. Meets second Thursday of each month October to May inclusive at the Palmer House.

Cincinnati Radiological Society
Secretary, Dr. H. G. Reineke, General Hospital, Cincinnati, Ohio. Meets third Monday of each month, October to May, inclusive.

Cleveland Radiological Society
Secretary, Dr. Otto Glasser, Cleveland Clinic. Meetings are held at 6:30 P.M. at the Cleveland Chamber of Commerce Club rooms on the fourth Monday of each month from October to April, inclusive.

Detroit Roentgen Ray and Radium Society
Secretary, Dr. E. R. Witwer, Harper Hospital. Meets monthly on first Thursday from October to May, at Wayne Country Medical Society Building.

Florida Radiological Society
Secretary, Dr. F. J. Payton, Miami Beach, Florida. Meetings held twice a year, May and November.

Illinois Radiological Society
Secretary, Dr. H. W. Grote, 219 N. Main St., Bloomington, Ill. Regular meetings held quarterly.

Indiana Roentgen Society
Secretary, Dr. J. N. Collins, Indianapolis, Ind. Annual meeting each February 22 in Indianapolis.

Michigan Association of Roentgenologists
Secretary, Dr. S. W. Donaldson, St. Joseph's Mercy Hospital, Ann Arbor, Mich. Three meetings a year, Fall, Winter, and Spring.

Milwaukee Roentgen Ray Society
Secretary, Dr. S. A. Morton, Columbia Hospital, Milwaukee, Wis. Meets monthly. Place of meeting designed by the president.

Minnesota Radiological Society
Secretary, Dr. L. G. Rigler, University Hospital, Minneapolis, Minn.

New England Roentgen Ray Society
Secretary, Dr. Thomas R. Healy, 370 Marlboro St., Boston, Mass. Meets monthly on third Friday, Boston Medical Library.

Radiological Society of New Jersey
Secretary, Dr. P. S. Avery, New Brunswick, N. J. Meets annually at time and place of State Medical Society. Mid-year meetings at place designated by the president.

New York Roentgen Society
Secretary, Dr. E. F. Merrill, 30 W. 59th St., New York. Meets monthly on third Monday, New York Academy of Medicine, at 8:00 P.M.

North Carolina Roentgen Ray Society
Secretary, Dr. Major Fleming, Rocky Mount, N. C. Annual meeting at time and place of State Medical Society. Mid-year scientific meeting at place designated.

Central New York Roentgen Ray Society
Secretary, Dr. F. C. Rulison, Medical Arts Bldg., Syracuse, N.Y. Three meetings a year—January, May, and November.

Pacific Roentgen Club
Secretary, Dr. L. H. Garland, 450 Sutter St., San Francisco, Calif. Meets annually, during meeting of California Medical Association

Pennsylvania Radiological Society
Secretary, Dr. L. E. Wurster, Williamsport, Pa. Annual meeting, Schenley Hotel, Pittsburgh, Pa., May 17–18, 1935.

Philadelphia Roentgen Ray Society
Secretary, Dr. Thomas Loughery, Germantown Hospital. Meeting first Thursday of each month from October to May inclusive, at 8:15 P.M., in Thompson Hall, College of Physicians, 19 S. 22d St.

Rochester Roentgen Ray Society, Rochester, N.Y.
Secretary, Dr. W. W. Fray, Strong Memorial Hospital. Meets monthly on second Thursday from October to May, inclusive, at 7:45 at the Rochester Medical Association Building.

St. Louis Roentgen Ray Society
Secretary, Dr. P. C. Schnoebelen, Missouri Bldg., St. Louis, Mo. Meets first week of each month. Time and place of meetings designated by president.

South Carolina X-Ray Society
Secretary, Dr. R. B. Taft, 105 Rutledge Ave., Charleston. Meets at time and place of South Carolina State Medical Association.

Tennessee Radiological Society
Secretary, Dr. F. B. Bogart, 311 Medical Arts Bldg.

* Secretaries of Societies not here listed are requested to send the necessary information to the Editor.

Chattanooga, Tenn. Meets annually at the time and place of the Tennessee State Medical Association.

TEXAS RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. J. H. Smith, Lubbock, Texas.
Meets annually one day preceding the meeting of the Texas State Medical Association.

UNIVERSITY OF MICHIGAN DEPARTMENT OF ROENTGENOLOGY STAFF MEETING
Secretary, Dr. C. B. Peirce, University Hospital, Ann Arbor, Mich.
Meets each Monday evening from September to June, at 7 P.M. at University Hospital.

UNIVERSITY OF WISCONSIN ROENTGEN CLUB
Secretary, Dr. E. A. Pohle, 1300 University Ave., Madison, Wis.
Meets monthly on last Thursday, October to April, Service Memorial Institute, at 4:30 P.M.

VIRGINIA ROENTGEN RAY CLUB
Secretary, Dr. V. W. Archer, University Hospital, University, Va.
Meets annually in October.

CUBA

SOCIEDAD CUBANA DE RADIOLOGIA Y FISIOTERAPIA
Secretary, Dr. Francisco Padron, Enrique, Villuendas 64, Havana, Cuba. Meets monthly in Havana.

BRITISH EMPIRE

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY
Meets on the third Thursday of each month, from November to June inclusive, at 8:15 P.M., at 32 Welbeck St., London, W. 1, or as advertised.

ELECTRO-THERAPEUTIC SECTION OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)
Meets on the third Friday of each month during the winter at 8:30 P.M. at the Royal Society of Medicine, 1 Wimpole St., London, W. 1.

SECTION OF RADIOLOGY AND MEDICAL ELECTRICITY, AUSTRALASIAN MEDICAL CONGRESS
Secretary, Dr. H. M. Cutler, 139 Macquarie St., Sydney, New South Wales.

RADIOLOGICAL SECTION OF THE VICTORIAN BRANCH OF THE BRITISH MEDICAL ASSOCIATION
Secretary, Dr. Colin Macdonald, Lister House, 61 Collins St., Melbourne, Australia.
Meets monthly at Melbourne during the winter.

SECTION ON RADIOLOGY, CANADIAN MEDICAL ASSOCIATION
Secretary, Dr. A. H. Rolph, 160 St. George St., Toronto, Ont.

RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION
Secretary, Dr. P. C. Fenwick, The Hospital, Christchurch. Meets annually.

CONTINENTAL EUROPE

BELGIAN SOCIETY OF ROENTGENOLOGY
Secretary, Dr. J. Boine, Avenue des Alliés, 134, Louvain (Belgium).
Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

SOCIÉTÉ DE RADIOLOGIE MÉDICALE DE FRANCE
Meets monthly on second Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

SOCIÉTÉ SUISSE DE RADIOLOGIE (SCHWEIZERISCHE RÖNTGEN-GESELLSCHAFT)
Secretary for French language, Dr. A. Grosjean, La Chaux de Fonds.
Secretary for German language, Dr. Scheurer, Molzgasse, Biel.
Meets annually in different cities.

SOCIÉTÉ FRANCAISE D'ELECTROTHÉRAPIE ET DE RADIOLOGIE MÉDICALE.
Meets monthly on fourth Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

ASSOCIATION OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS IN CZECHO-SLOVAKIA
Secretary, Dr. Walter Altschul, German University, Prague, II.52.

DEUTSCHE RÖNTGEN-GESELLSCHAFT (GESELLSCHAFT FÜR RÖNTGENKUNDE UND STRAHLENFORSCHUNG)
Meets annually in April, alternating one year in Berlin, one year in some other German city. Meets in addition every two years with the Gesellschaft deutscher Naturforscher und Aerzte.
Permanent secretary, Professor Dr. Haenisch, Klopstockstrasse 10, Hamburg, Germany.

SÜD- UND WESTDEUTSCHE RÖNTGENGESELLSCHAFT
Meets annually in different cities.

NORD- UND OSTDEUTSCHE RÖNTGENGESELLSCHAFT
Meets annually in different cities.

DUTCH SOCIETY OF ELECTROLOGY AND ROENTGENOLOGY
Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

SOCIETA ITALIANA RADIOLOGIA MEDICA
Secretary, Professor M. Ponzio, University of Turin, Turin.

SOCIETATEA ROMANA DE RADIOLOGIE SI ELECTROLOGIE
Secretary, Dr. Nicolae Busila, 44 Elizabeta Blvd., Bucarest.
Meets second Monday in every month with the exception of July and August.

ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD, USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs. S. A. Reinberg and S. G. Simonson.
Meets annually.

LENINGRAD ROENTGEN RAY SOCIETY
Secretaries, Drs. S. G. Simonson and G. A. Gusterin.
Meets monthly, first Monday at 8 o'clock State Institute of Roentgenology and Radiology, Leningrad.

MOSCOW ROENTGEN RAY SOCIETY
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky.
Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society.

POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. Jan. Kochanowski, 45 Gornoslazka St., Warsaw. Meets annually.

WARSAW SECTION, POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. B. Krynski, 11 Zielna St.
Meets once a month except in the summertime.

SCANDINAVIAN ROENTGEN SOCIETIES
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies, with exception of the Denmark Society, meets every second month except in the summertime.

SOCIETY OF MEDICAL RADIOLOGY IN SWEDEN
Meets in Stockholm.

SOCIETY OF MEDICAL RADIOLOGY IN NORWAY
Meets in Oslo.

SOCIETY OF MEDICAL RADIOLOGY IN DENMARK
Secretary, Dr. G. Biering, Copenhagen.
Meets on the second Wednesday of each month from October to July in Copenhagen, at 8 o'clock in the State Institute of Roentgenology.

SOCIETY OF MEDICAL RADIOLOGY IN FINLAND
Meets in Helsingfors.

VIENNA SOCIETY OF ROENTGENOLOGY
Secretary, Professor Holzknecht, Vienna, IX, General Hospital.
Meets first Tuesday each month, October to July.

ORIENT

JAPAN X-RAY ASSOCIATION
c/o Orthopedic Surgery, Tokyo Imperial University.
Meets annually in April.

KINKI ROENTGEN-ABEND SOCIETY
Director, Dr. Prof. Taiga Saito, Ogawaoike Tyoto, Japan. Meets bi-monthly on third Sunday.

SURGEONS TO MEET IN JACKSONVILLE, FLORIDA

The Southeastern Surgical Congress, through its secretary, Dr. B. T. Beasley, announces the sixth annual assembly of the Congress which will be held in Jacksonville, Florida, March 11, 12 and 13, 1935. The Congress has met previously in Atlanta, Birmingham and Nashville.

The states composing the Congress are Albama, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee and Virginia. A record attendance is anticipated at the Jacksonville meeting. Since March is the most desirable month to visit the land of flowers many surgeons will no doubt combine business and pleasure and attend during this season of the year.

Some of the most distinguished surgeons in the country representing the different surgical specialties have been invited to appear on the program. A partial list of those who have already accepted places is as follows: Doctors Walter C. Alvarez, Perry Bromberg, Hugh Cabot, Willis C. Campbell, George W. Crile, John F. Erdmann, Paul Flothow, Ralph Green, Arthur Hertzler, C. Jeff Miller, Alton Ochsner, J. C. Patterson, J. Knox Simpson, J. W. Snyder and W. A. Weldon. More than twenty others will be listed when the program is completed. Look for the completed program which will be mailed about February 15, 1935.

For information address Dr. B. T. Beasley, Secretary-treasurer, 1019 Doctors Building, Atlanta, Georgia.

FLORIDA RADIOLOGICAL SOCIETY

A meeting of the Florida Radiological Society was held on October 27, 1934, at St. Petersburg. The Society was the guest of Dr. Stevens of the United States Veterans Hospital. The officers elected at the Spring meeting in Jacksonville officiated. They are as follows: Dr. Frederick K. Herpel, President; Dr. W. McL. Shaw, Vice-President; Dr. Frazier J. Payton, Secretary-Treasurer. The meeting consisted of a morning session—a round table discussion of interesting and problematical cases. The afternoon session consisted of a symposium on Radiation Therapy led by Dr. Cunningham of Jacksonville. A dinner was held at the Seminole Club, followed by an evening session devoted to economics.

MINNESOTA RADIOLOGICAL SOCIETY

The Fall meeting of the Minnesota Radiological Society was held at Rochester, Minnesota, October 13, 1934. The program was presented by the staff of the Mayo Clinic and was as follows:

Xanthomatosis: Clinical Aspects. Dr. R. L. J. Kennedy; Roentgenologic Aspects. Dr. J. D. Camp.

Backache. Dr. R. K. Ghormley.

Interesting Diagnostic Problems. Dr. J. D. Coate.

Mortality Studies on Carcinoma of the Cervix. Dr. R. E. Fricke.

The Duodenal Niche. Dr. H. A. Burch.

Osteopoikilosis and Allied Diseases of Bone. Dr. C. G. Sutherland.

Limits of Safety in Roentgenography. Dr. A. Turnbull.

The International Congress of Radiology at Zurich and St. Moritz. Dr. A. U. Desjardins.

Address: Some Effects of Radiation. Dr. C. Sheard.

MID-WINTER MEETING

The Mid-Winter meeting of the New England Roentgen Ray Society will be held January 25 and 26, 1935, in Boston. The New York, Philadelphia, Baltimore, and Washington Societies have been invited to participate. All other roentgenologists not members of these societies are also invited to attend. The meetings will be held at the Massachusetts General Hospital, Boston City Hospital and Peter Bent Brigham Hospital.

T. R. Healy, *President*

NEW OFFICERS

The officers for the Radiological Section of the Los Angeles County Medical Association for 1935 are as follows: President, Dr. Clayton Johnson; Vice-President, Dr. J. W. Crosson; Treasurer, Dr. Henry Snure; Secretary, Dr. E. N. Liljedahl. Meetings are held the fourth Wednesday of each month.

DIPLOMATES OF THE AMERICAN BOARD OF RADIOLOGY

The following is a list of the diplomates of The American Board of Radiology who appeared before the Board and passed a satisfactory examination in Cleveland, Pittsburgh or Memphis and who were granted certificates:

1. ALLEN, BUNDY, Tampa, Fla., *Radiology*.
2. ALLEN, KENNETH DAYTON ALLISON, Denver, Colo., *Radiology*.
3. ALLEN, LEWIS G., Kansas City, Mo., *Radiology*.
4. ALLEN, MOORE LOWRY, Philadelphia, Pa., *Radiology*.
5. ALLEY, REUBEN G., Pittsburgh, Pa., *Diagnostic Roentgenology*.
6. ALLISON, R. G., Minneapolis, Minn., *Roentgenology*.
7. ANE, JOSEPH NOVELL, New Orleans, La., *Radiology*.
8. ARCHER, VINCENT WILLIAM, University, Va., *Roentgenology*.
9. ARENS, Robert A., Chicago, Ill., *Roentgenology*.
10. ASHBURY, HOWARD E., Baltimore, Md., *Roentgenology*.
11. ATKINS, SAMUEL M., Waterbury, Conn., *Roentgenology*.
12. AURELIUS, J. RICHARDS, St. Paul, Minn., *Roentgenology*.
13. BACHMAN, M. H., Youngstown, Ohio, *Roentgenology*.
14. BADER, ELLIS R., Cincinnati, Ohio, *Radiology*.
15. BAILEY, WILBUR, Philadelphia, Pa., *Radiology*.
16. BAKER, CHARLES FREDERICK, Newark, N.J., *Roentgenology*.
17. BAKER, EDGAR C., Youngstown, Ohio, *Radiology*.
18. BARNES, JOHN MCGREGOR, Buffalo, N.Y., *Roentgenology*.
19. BARROW, SIDNEY CONROY, Shreveport, La., *Radiology*.
20. BARTH, EARL E., Chicago, Ill., *Roentgenology*.
21. BAUER, AUGUST A., Chicago, Ill., *Roentgenology*.
22. BAUM, SAMUEL M., New York, N.Y., *Therapeutic Radiology*.
23. BEELER, RAYMOND COLE, Indianapolis, Ind., *Radiology*.
24. BEILIN, D. S., Chicago, Ill., *Radiology*.
25. BELL, JOSEPH CLARK, Louisville, Ky., *Roentgenology*.
26. BENISHEK, WERNER L., Aurora, Ill., *Roentgenology*.
27. BENJAMIN, EMANUEL WILLIAM, Providence, R.I., *Radiology*.
28. BERG, H. MILTON, Bismarck, N.D., *Radiology*.
29. BETHEA, WILLIAM R., Memphis, Tenn., *Roentgenology*.
30. BISHOP, PAUL A., Philadelphia, Pa., *Radiology*.
31. BLACKETT, CHARLES W., Boston, Mass., *Roentgenology*.
32. BLAINE, EDWARD S., Los Angeles, Cal., *Roentgenology*.
33. BLISS, GERALD D., Altoona, Pa., *Radiology*.
34. BOGAN, ISABEL KATHERINE, Boston, Mass., *Roentgenology*.
35. BOGAN, MARY ELIZABETH, Brookline, Mass., *Roentgenology*.
36. BOGART, FRANKLIN B., Chattanooga, Tenn., *Roentgenology*.
37. BORZELL, FRANCIS FRANK, Philadelphia, Pa., *Radiology*.
38. BOWEN, DAVID RALPH, Philadelphia, Pa., *Radiology*.
39. BOWING, H. H., Rochester, Minn., *Therapeutic Radiology*.
40. BRAMS, JULIUS, Chicago, Ill., *Radiology*.
41. BRENNEMAN, RICHARD E., Meadville, Pa., *Therapeutic Radiology*.
42. BROMER, RALPH S., Bryn Mawr, Pa., *Radiology*.
43. BROOKSHER, WILLIAM RILEY, Fort Smith, Ark., *Radiology*.
44. BROUSE, IVAN EDWIN, Jacksonville, Ill., *Roentgenology*.
45. BROWN, PERCY, Boston, Mass., *Roentgenology*.
46. BROWN, SAMUEL, Cincinnati, Ohio, *Roentgenology*.
47. BRYAN, LLOYD, San Francisco, Cal., *Roentgenology*.
48. BURCHAM, THOS. A., Des Moines, Iowa, *Radiology*.
49. BUTLER, P. F., Boston, Mass., *Radiology*.
50. CALDWELL, CHARLES S., Pittsburgh, Pa., *Roentgenology*.
51. CAMP, JOHN DEXTER, Rochester, Minn., *Roentgenology*.
52. CAPP, CHARLES S., San Antonio, Tex., *Radiology*.
53. CARTER, RAY ALDEN, Los Angeles, Cal., *Roentgenology*.
54. CARTY, JOHN RUSSELL, New York, N.Y., *Radiology*.
55. CASE, JAMES THOMAS, Chicago, Ill., *Radiology*.
56. CATHCART, JOHN WATSON, El Paso, Tex., *Radiology*.
57. CHALLENGER, CHESTER JOHN, Chicago, Ill., *Roentgenology*.
58. CHAMBERLAIN, W. EDWARD, Philadelphia, Pa., *Radiology*.
59. CHILDS, DONALD SMYTHE, Syracuse, N.Y., *Roentgenology*.
60. CHRISTIE, ARTHUR CARLISLE, Washington, D. C., *Radiology*
61. CLARK, JAMES J., Atlanta, Ga., *Roentgenology*.
62. CLARK, STANLEY A., South Bend, Ind., *Radiology*.
63. CLEMENT, GAGE, Duluth, Minn., *Radiology*.
64. COE, FREDERICK O., Washington, D.C., *Radiology*.
65. COLE, LEWIS GREGORY, New York City, *Roentgenology*.
66. COLEY, STEPHEN W., Memphis, Tenn., *Roentgenology*.
67. COLLINS, JAMES N., Indianapolis, Ind., *Radiology*.
68. COLLINS, JOHN JOSEPH, Thomasville, Ga., *Radiology*.
69. CORCORAN, WILLIAM JOSEPH, Old Forge, Pa., *Roentgenology*.
70. COSTOLOW, WILLIAM EVERT, Los Angeles, Cal., *Therapeutic Radiology*.
71. CRAIN, CARROLL FRANCIS, Corpus Christi, Tex., *Radiology*.
72. CRAMP, GEORGE W., Brooklyn, N.Y., *Roentgenology*.
73. CRANE, AUGUSTUS WARREN, Kalamazoo, Mich., *Roentgenology*.
74. CROSSAN, JOHN W., Los Angeles, Cal., *Diagnostic Roentgenology*.
75. CROWDER, E. R., Chicago, Illinois, *Roentgenology*.
76. CUNNINGHAM, LESTER W., Jacksonville, Fla., *Roentgenology*.
77. CURRIN, FRANCIS W., Brooklyn, N.Y., *Roentgenology*.
78. CUSHWAY, BERTRAM CHARLES, Chicago, Ill., *Radiology*.
79. DANN, DAVID S., Kansas City, Mo., *Radiology*.
80. DAVIDSON, SOL C., Rochester, N.Y., *Roentgenology*.
81. DAVIS, HENRY B., Lancaster, Pa., *Radiology*.
82. DAVIS, KENNETH S., Los Angeles, Cal., *Roentgenology*.
83. DECKER, FRED HENRY, Peoria, Ill., *Radiology*.
84. DERR, JOHN SEBASTIAN, Frederick, Md., *Roentgenology*.
85. DESJARDINS, ARTHUR U., Rochester, Minn., *Radiology*.
86. DEWEESE, E. R., Kansas City, Mo., *Radiology*.
87. DICKINSON, JOSHUA C., Tampa, Florida, *Roentgenology*.
88. DONALDSON, SAMUEL WRIGHT, Ann Arbor, Mich., *Roentgenology*.
89. DOUB, HOWARD PHILIP, Detroit, Mich., *Radiology*.
90. DOUGHTY, WILLIAM M., Cincinnati, Ohio, *Radiology*.
91. DOWNS, ELWOOD EMERSON, Woodbury, N.J., *Radiology*.
92. DRANE, ROBERT, Savannah, Ga., *Roentgenology*.
93. DUNHAM, H. KENNON, Cincinnati, Ohio, *Diagnostic Roentgenology*.
94. EASTMOND, CHAS., Brooklyn, N.Y., *Roentgenology*.
95. EDWARDS, HAROLD GUEGNON FABIEN, Shreveport, La., *Radiology*.
96. EDWARDS, JAMES BENNETT, Leonia, N.J., *Roentgenology*.
97. ELEY, CLAYTON W., Norfolk, Va., *Roentgenology*.
98. ELWARD, JOSEPH FRANCIS, Washington, D.C., *Roentgenology*.
99. ERNST, EDWIN C., St. Louis, Mo., *Radiology*.
100. ERSKINE, ARTHUR WRIGHT, Cedar Rapids, Iowa, *Radiology*.
101. EVANS, WILLIAM A., Detroit, Mich., *Radiology*.
102. EVELETH, FRED SHAILER, Concord, N.H., *Roentgenology*.
103. FARMER, HARRY L., Cleveland, Ohio, *Radiology*.
104. FARRELL, JOHN T., JR., Philadelphia, Pa., *Roentgenology*.
105. FEASTER, ORION OTIS, St. Petersburg, Fla., *Radiology*.
106. FERGUSON, JAMES W., Pittsburgh, Pa., *Radiology*.
107. FLYNN, JAMES MURRAY, Rochester, N.Y., *Radiology*.
108. FORD, FRANCES A., Detroit, Michigan, *Radiology*.
109. FRAY, WALTER WENDELL, Rochester, N.Y., *Radiology*.
110. FREEDMAN, EUGENE, Cleveland, Ohio, *Roentgenology*.
111. FREEDMAN, JOHN, Detroit, Mich., *Roentgenology*.

112. Freid, Jacob R., New York, N.Y., *Therapeutic Radiology.*
113. Fricke, Robert Elmer, Rochester, Minn., *Therapeutic Radiology.*
114. Friedman, Jacob, Montreal, Quebec, *Roentgenology.*
115. Friedman, Milton, Newark, N.J., *Therapeutic Radiology.*
116. Furey, Warren W., Chicago, Ill., *Radiology.*
117. Garland, L. Henry, San Francisco, Cal., *Radiology.*
118. Gates, Russell, Minot, N.D., *Roentgenology.*
119. Gerber, Isaac, Providence, R.I., *Radiology.*
120. Gershon-Cohen, Jacob, Philadelphia, Pa., *Radiology.*
121. Geyman, Milton J., Santa Barbara, Cal., *Diagnostic Roentgenology.*
122. Gianturco, Cesare, Urbana, Ill., *Roentgenology.*
123. Gillies, Carl L., Cedar Rapids, Iowa, *Radiology.*
124. Goin, Lowell S., Los Angeles, Cal., *Roentgenology.*
125. Golden, Ross, New York, N.Y., *Roentgenology.*
126. Goldsmith, Maurice F., Pittsburgh, Pa., *Roentgenology.*
127. Goodrich, Murray Eugene, Toledo, Ohio, *Radiology.*
128. Goodwin, Perry Bird, Peoria, Ill., *Radiology.*
129. Gorsline, Clarence S., Battle Creek, Mich., *Roentgenology.*
130. Granger, Amedee, New Orleans, La., *Diagnostic Roentgenology.*
131. Grier, George W., Pittsburgh, Pa., *Radiology.*
132. Groover, Thomas Allen, Washington, D.C., *Radiology.*
133. Habbe, J. Edwin, Milwaukee, Wis., *Diagnostic Roentgenology.*
134. Hall, E. Walter, Detroit, Mich., *Radiology.*
135. Hankins, John Logan, Johnson City, Tenn., *Roentgenology.*
136. Harding, Donnan B., Lexington, Ky., *Radiology.*
137. Harrington, Bernard D., Tacoma, Wash., *Radiology.*
138. Harris, John H., Harrisburg, Pa., *Radiology.*
139. Hartung, Adolph, Chicago, Ill., *Roentgenology.*
140. Hasley, Clyde Knapp, Detroit, Mich., *Radiology.*
141. Hauser, Harry, Cleveland, Ohio, *Radiology.*
142. Hawley, Sydney James, Danville, Pa., *Roentgenology.*
143. Hay, Percy D. Jr., Florence, S.C., *Radiology.*
144. Heacock, Charles Hunter, Memphis, Tenn., *Roentgenology.*
145. Healy, Thomas Raymond, Boston, Mass., *Roentgenology.*
146. Heatley, John E., Oklahoma City, Okla., *Diagnostic Roentgenology.*
147. Heberding, John, Youngstown, Ohio, *Radiology.*
148. Hefke, Hans W., Milwaukee, Wis., *Radiology.*
149. Hendricks, Elliott Miley, Ft. Lauderdale, Fla., *Roentgenology.*
150. Hendrickson, Anna R., Canton, Ohio, *Roentgenology.*
151. Henry, Lucas Smith, Syracuse, N.Y., *Diagnostic Roentgenology.*
152. Herpel, Frederick Karl, West Palm Beach, Fla., *Roentgenology.*
153. Herrman, William Gettier, Asbury Park, N.J., *Radiology.*
154. Hill, Walter Coit, Cleveland, Ohio, *Roentgenology.*
155. Hilt, Lawrence Mershon, Springfield, Ill., *Roentgenology.*
156. Hodges, Fred Jenner, Ann Arbor, Mich., *Radiology.*
157. Hodges, Fred M., Richmond, Va., *Radiology.*
158. Hodges, Paul C., Chicago, Ill., *Radiology.*
159. Holly, Leland E., Muskegon, Mich., *Roentgenology.*
160. Holmes, George Winslow, Boston, Mass., *Radiology.*
161. Holmes, Ralph Williams, Chillicothe, Ohio, *Roentgenology.*
162. Howes, William Edward, Brooklyn, N.Y., *Radiology.*
163. Hubeny, Maxmillian John, Chicago, Ill., *Roentgenology.*
164. Hufford, C. E., Toledo, Ohio, *Radiology.*
165. Hut, Howard B., Omaha, Neb., *Radiology.*
166. Hunter, James Wilson, Jr., Norfolk, Va., *Radiology.*
167. Ikeda, Kano, St. Paul, Minn., *Roentgenology.*
168. Imboden, Harry M., New York, N.Y., *Roentgenology.*
169. Ivey, H. B., Goldsboro, N. C., *Diagnostic Roentgenology.*
170. Jaches, Leopold, New York, N.Y., *Radiology.*
171. Jackson, Byron Hubbard, Scranton, Pa., *Radiology.*
172. Jacox, Harold William, Ann Arbor, Mich., *Radiology.*
173. Jarre, Hans A., Detroit, Mich., *Radiology.*
174. Jenkinson, Edward L., Chicago, Ill., *Radiology.*
175. Johnson, Ellsworth, Winchester, Va., *Diagnostic Roentgenology.*
176. Johnson, Jesse B., Galveston, Tex., *Radiology.*
177. Johnson, Vincent Clifton, Ann Arbor, Mich., *Radiology.*
178. Kahn, Max., Baltimore, Md., *Roentgenology.*
179. Kalbfleisch, William K., Wheeling, W. Va., *Roentgenology.*
180. Kann, Ulysses S., Binghampton, N.Y., *Radiology.*
181. Kaplan, Ira I., New York, N.Y., *Therapeutic Radiology.*
182. Kasabach, Haig Haigouni, New York, N.Y., *Radiology.*
183. Keichline, John M., Huntingdon, Pa., *Radiology.*
184. Keith, David Yandell, Louisville, Ky., *Radiology.*
185. Kelly, James Francis, Omaha, Neb., *Radiology.*
186. Kenning, John Carl, Detroit, Mich., *Radiology.*
187. Kerby, James P., Salt Lake City, Utah, *Roentgenology.*
188. Kerr, H. Dabney, Iowa City, Iowa, *Radiology.*
189. Kinney, Lyell Cary, San Diego, Cal., *Radiology.*
190. Kirklin, B. R., Rochester, Minn., *Radiology.*
191. Kolvoord, Theodore, Battle Creek, Mich., *Diagnostic Roentgenology.*
192. Kornblum, Karl, Philadelphia, Pa., *Radiology.*
193. Kuegle, Frederick H., Janesville, Wis., *Diagnostic Roentgenology.*
194. Lafferty, Robert Hervey, Charlotte, N. C., *Radiology.*
195. Lange, Sidney, Cincinnati, Ohio, *Radiology.*
196. Langer, Heinz, Pittsburgh, Pa., *Therapeutic Radiology.*
197. Larkey, Charles J., Bayonne, N. J., *Diagnostic Roentgenology.*
198. Lattman, Isidore, Washington, D. C., *Radiology.*
199. Lawrence, W. S., Memphis, Tenn., *Radiology.*
200. Leddy, Eugene Thomas, Rochester, Minn., *Radiology.*
201. Leibert, Harry F., Bethlehem, Pa., *Roentgenology.*
202. Lenz, Maurice, New York, N.Y., *Therapeutic Radiology.*
203. Leonard, Ralph D., Boston, Mass., *Roentgenology.*
204. Leucutia, Traian, Detroit, Mich., *Radiology.*
205. Levi, Irwin P., Anniston, Ala., *Diagnostic Roentgenology.*
206. Le Vine, David, Eldorado, Ark., *Diagnostic Roentgenology.*
207. Levyn, Lester, Buffalo, N.Y., *Diagnostic Roentgenology.*
208. Lhevine, Morris B., Tulsa, Okla., *Roentgenology.*
209. Lingeman, Leslie Roberts, Rochester, N.Y., *Roentgenology.*
210. Littig, Lawrence Victor, Madison, Wis., *Diagnostic Roentgenology.*
211. Lochry, Ralph L., Indianapolis, Ind., *Roentgenology.*
212. Lockwood, Ira H., Kansas City, Mo., *Radiology.*
213. Lucinian, Joseph H., Miami, Fla., *Roentgenology.*
214. Lutz, Jeremiah Fletcher, York, Pa., *Roentgenology.*
215. McClure, Christopher C., Nashville, Tenn., *Radiology.*
216. McCormick, Arthur Foster, Dubois, Pa., *Diagnostic Roentgenology.*
217. McCormick, Henry Garnsey, Laurel, Miss., *Roentgenology.*
218. McCullough, John Fife, Pittsburgh, Pa., *Radiology.*
219. McDeed, Winfield G., Houston, Tex., *Roentgenology.*
220. McDermott, Joseph L., Kansas City, Mo., *Radiology.*
221. McElfatrick, George Charles, Wilmington, Del., *Roentgenology.*
222. McGee, Harry Hand, Savannah, Ga., *Diagnostic Roentgenology.*
223. McGuffin, W. Herbert, Calgary, Alberta, *Radiology.*
224. McHenry, R. K., Houston, Tex., *Roentgenology.*
225. McKinney, Joseph T., Roanoke, Va., *Roentgenology.*
226. McNamee, Edgar Paul, Cleveland, Ohio, *Diagnostic Roentgenology.*
227. McNutt, John Roscoe, Duluth, Minn., *Radiology.*
228. Magruder, L. Freeland, Norfolk, Va., *Radiology.*
229. Maier, Roe J., Chicago, Ill., *Radiology.*
230. Malone, L. A., Terre Haute, Ind., *Diagnostic Roentgenology.*
231. Mandeville, Frederick B., Richmond, Va., *Roentgenology.*
232. Manges, Willis F., Philadelphia, Pa., *Radiology.*
233. Marquis, W. James, Newark, N. J., *Roentgenology.*
234. Martin, Charles Louis, Dallas, Tex., *Radiology.*
235. Martin, James Madison, Dallas, Tex., *Radiology.*
236. May, Ernst Albert, East Orange, N. J., *Radiology.*
237. May, Robert John, Cleveland, Ohio, *Radiology.*

238. MAYFIELD, CLAUD, Long Beach, Cal., *Diagnostic Roentgenology.*
239. MEADOWS, JAMES ALLEN, Birmingham, Ala., *Radiology.*
240. MELAND, ORVILLE NEWTON, Los Angeles, Cal., *Therapeutic Radiology.*
241. MENEES, THOMAS ORVILLE, Grand Rapids, Mich., *Radiology.*
242. MENVILLE, LEON J., New Orleans, La., *Radiology.*
243. MERCHANT, ALBERT K., Philadelphia, Pa., *Radiology.*
244. MEYER, KEITH THOMAS, Evansville, Ind., *Roentgenology.*
245. MEYER, WILLIAM H., New York, N. Y., *Radiology.*
246. MILKMAN, LOUIS A., Scranton, Pa., *Roentgenology.*
247. MINOR, EDWARD G., Detroit, Mich., *Diagnostic Roentgenology.*
248. MOORE, A. B., Washington, D.C., *Radiology.*
249. MOORE, CLAUDE, Washington, D.C., *Radiology.*
250. MOORE, JOHN JAY, Washington, D.C., *Radiology.*
251. MOORE, PAUL DAVID, Muncie, Ind., *Radiology.*
252. MOORE, SHERWOOD, St. Louis, Mo., *Radiology.*
253. MOORE, VERNOR MILO, Grand Rapids, Mich., *Radiology.*
254. MORSE, RUSSELL WRIGHT, Minneapolis, Minn., *Roentgenology.*
255. MORTON, SILVANUS ARCHIBALD, Milwaukee, Wis., *Radiology.*
256. MOXNESS, BENNIE ARTHUR, Northampton, Mass., *Diagnostic Roentgenology.*
257. MULLIGAN, PETER BURRILL, Ashland, Pa., *Roentgenology.*
258. MURPHY, GIBBONS WESTBROOK, Asheville, N.C., *Roentgenology.*
259. MURPHY, JOHN T., Toledo, Ohio, *Radiology.*
260. MYERS, RALPH E., Oklahoma City, Okla., *Radiology.*
261. NESSA, NELIUS JULIAN, Sioux Falls, S.D., *Roentgenology.*
262. NEWCOMET, WILLIAM STELL, Philadelphia, Pa., *Radiology.*
263. NICHOLS, BERNARD H., Cleveland, Ohio, *Radiology.*
264. NICHOLS, HAROLD E., Seattle, Wash., *Diagnostic Roentgenology.*
265. NORDIN, GUSTAF THEODORE, Minneapolis, Minn., *Radiology.*
266. O'BRIEN, FREDERICK WILLIAM, Boston, Mass., *Radiology.*
267. OLIN, HARRY, Chicago, Ill., *Roentgenology.*
268. ORNDOFF, BENJAMIN HARRY, Chicago, Ill., *Radiology.*
269. ORR, CLIFFORD R., Buffalo, N.Y., *Radiology.*
270. OSMOND, JOHN D., Cleveland, Ohio, *Roentgenology.*
271. OVERGAARD, ANDERS P., Omaha, Neb., *Radiology.*
272. OWEN, ARTHUR K., Topeka, Kan., *Roentgenology.*
273. PAINE, ROBERT, Memphis, Tenn., *Radiology.*
274. PALMER, DORWIN LEWIS, Portland, Ore., *Radiology.*
275. PANCOAST, HENRY K., Philadelphia, Pa., *Radiology.*
276. PAWLING, JESSE R., Watertown, N.Y., *Diagnostic Roentgenology.*
277. PEDEN, JOSEPH C., St. Louis, Mo., *Roentgenology.*
278. PEIRCE, CARLETON BARNHART, Ann Arbor, Mich., *Radiology.*
279. PENDERGRASS, EUGENE PERCIVAL, Philadelphia, Pa., *Radiology.*
280. PERRY, GENTZ, Evanston, Ill., *Radiology.*
281. PETERS, CHESTER M., Canton, Ohio, *Radiology.*
282. PETERSON, CHARLES HANSON, Roanoke, Va., *Roentgenology.*
283. PETERSON, VERNON L., Charleston, W.Va., *Radiology.*
284. PFAHLER, GEORGE EDWARD, Philadelphia, Pa., *Radiology.*
285. PHILLIPS, CLYDE COLUMBUS, Charlotte, N.C., *Radiology.*
286. PIERCE, HAROLD J., Terre Haute, Ind., *Radiology.*
287. PIERSON, JOHN WILLIAM, Baltimore, Md., *Roentgenology.*
288. PINDELL, MERL LEE, Los Angeles, Calif., *Diagnostic Roentgenology.*
289. PIRIE, ALEXANDER HOWARD, Montreal, Quebec, *Radiology.*
290. PITTS, THOMAS A., Columbia, S.C., *Roentgenology.*
291. PODLASKY, HARRY BERNARD, Milwaukee, Wis., *Roentgenology.*
292. POHLE, ERNST ALBERT, Madison, Wis., *Therapeutic Radiology.*
293. POMERANZ, MAURICE M., New York, N.Y., *Radiology.*
294. POMEROY, LAWRENCE A., Cleveland, Ohio, *Radium Therapy.*
295. PORTMANN, URSUS V., Cleveland, Ohio, *Radiology.*
296. POTTER, CARLTON FRASIER, Syracuse, N.Y., *Roentgenology.*
297. POTTER, HOLLIS, Chicago, Ill., *Roentgenology.*
298. POTTER, ROY PILLING, Marshfield, Wis., *Roentgenology.*
299. POWERS, MARTIN THOMAS, Utica, N.Y., *Diagnostic Roentgenology.*
300. PROUTY, JAMES V., Terre Haute, Ind., *Radiology.*
301. PUTTS, B. SWAYNE, Erie, Pa., *Roentgenology.*
302. QUICK, DOUGLAS, New York, N.Y., *Therapeutic Radiology.*
303. QUIMBY, A. JUDSON, New York, N.Y., *Roentgenology.*
304. QUINEY, JAMES J., Easton, Pa., *Radiology.*
305. RAAP, GERARD, Miami, Fla., *Radiology.*
306. RAUSCHENBACH, CHARLES WM., Hammond, Ind., *Roentgenology.*
307. RAY, WILLIAM BURTON GETTY, Pittsburgh, Pa., *Roentgenology.*
308. REAVES, HUGH G., Knoxville, Tenn., *Roentgenology.*
309. REEVES, ROBERT JAMES, Durham, N.C., *Radiology.*
310. REINEKE, HAROLD G., Cincinnati, Ohio, *Diagnostic Roentgenology.*
311. REITTER, GEORGE STILES, East Orange, N.J., *Radiology.*
312. REYNOLDS, LAWRENCE, Detroit, Mich., *Radiology.*
313. RHINEHART, DARMON A., Little Rock, Ark., *Roentgenology.*
314. RIGLER, LEO G., Minneapolis, Minn., *Radiology.*
315. RITVO, MAX, Boston, Mass., *Radiology.*
316. RITZMAN, ALLEN Z., Harrisburg, Pa., *Roentgenology.*
317. ROBINS, SAMUEL ALEXANDER, Boston, Mass., *Roentgenology.*
318. ROBINSON, RALPH V., Pittsburgh, Pa., *Roentgenology.*
319. ROBINSON, WALTER W., Memphis, Tenn., *Roentgenology.*
320. RODGERS, FLOYD D., Columbia, S.C., *Radiology.*
321. RODRIGUEZ, JUAN, Fort Wayne, Ind., *Diagnostic Roentgenology.*
322. ROLAND, MARION MANSFIELD, Oklahoma City, Okla., *Therapeutic Radiology.*
323. ROSE, CASSIE BELLE, Chicago, Ill., *Radiology.*
324. ROSENBAUM, GEORGE, Philadelphia, Pa., *Diagnostic Roentgenology.*
325. ROUSSEAU, JAMES P., Winston Salem, N.C., *Radiology.*
326. ROWE, EDWARD W., Lincoln, Neb., *Radiology.*
327. RUDISILL, HILLYER, JR., Charleston, S.C., *Radiology.*
328. RUTLEDGE, CLIFFORD P., Shreveport, La., *Diagnostic Roentgenology.*
329. RYPINS, EDWIN LOUIS, Iowa City, Iowa, *Radiology.*
330. SANTE, L. R., St. Louis, Mo., *Radiology.*
331. SCHMITZ, HENRY, Chicago, Ill., *Therapeutic Radiology.*
332. SCHONS, EDWARD, St. Paul, Minn., *Radiology.*
333. SHARPE, A. MAXWELL, Chester, Pa., *Roentgenology.*
334. SHAW, WILFRED MCLAURIN, Jacksonville, Fla., *Roentgenology.*
335. SHERRICK, EARL C., Connelsville, Pa., *Diagnostic Roentgenology.*
336. SHIFLETT, E. LEE, Indianapolis, Ind., *Roentgenology.*
337. SIMS, GEORGE P., Columbus, Ohio, *Therapeutic Radiology.*
338. SKINNER, EDWARD HOLMAN, Kansas City, Mo., *Radiology.*
339. SMITH, LESTER A., Indianapolis, Ind., *Radiology.*
340. SMYTH, THOS. L., Allentown, Pa., *Roentgenology.*
341. SNOW, HENRY, Dayton, Ohio, *Radiology.*
342. SNURE, HENRY, Los Angeles, Calif., *Roentgenology.*
343. SOILAND, ALBERT, Los Angeles, Calif., *Radiology.*
344. SOSMAN, MERRILL C., Boston, Mass., *Radiology.*
345. SPANGLER, DAVIS, Dallas, Tex., *Radiology.*
346. SPENCER, HUNTER B., Lynchburg, Va., *Roentgenology.*
347. SPILMAN, HAROLD AUGUSTUS, Ottumwa, Iowa, *Roentgenology.*
348. SPINZIG, EDGAR WALTER, St. Louis, Mo., *Radiology.*
349. SPROULL, JOHN, Haverhill, Mass., *Roentgenology.*
350. STAYTON, CHESTER A., Indianapolis, Ind., *Roentgenology.*
351. STEEL, DAVID, Cleveland, Ohio, *Roentgenology.*
352. STEINER, JOSEPH M., New York, N.Y., *Roentgenology.*
353. STEPHENSON, FRANK BUTLER, Denver, Col., *Radiology.*
354. STEVENS, ROLLIN HOWARD, Detroit, Mich., *Radiology.*
355. STEWART, WILLIAM H., New York, N.Y., *Roentgenology.*
356. STONE, ROBERT S., San Francisco, Calif., *Roentgenology.*
357. SUTHERLAND, CHARLES G., Rochester, Minn., *Diagnostic Roentgenology.*
358. SWENSON, PAUL C., New York, N.Y., *Roentgenology.*

359. Swope, Opie William, Wichita, Kan., *Radiology*.
360. Taft, Robert B., Charleston, S.C., *Radiology*.
361. Taylor, Clifford C., Indianapolis, Ind., *Radiology*.
362. Taylor, Henry Keller, New York, N.Y., *Diagnostic Roentgenology*.
363. Taylor, Raymond G., Los Angeles, Calif., *Radiology*.
364. Thomas, Merthyn Arthur, Cleveland, Ohio, *Radiology*.
365. Thompson, Harold B., Seattle, Wash., *Radiology*.
366. Tice, Galen M., Kansas City, Kan., *Radiology*.
367. Titterington, Paul F., St. Louis, Mo., *Roentgenology*.
368. Trostler, I. S., Chicago, Ill., *Roentgenology*.
369. Troup, Ralph L., Green Bay, Wis., *Radiology*.
370. Troxell, Wm. Chas., Allentown, Pa., *Roentgenology*.
371. Tyler, Albert Franklin, Omaha, Neb., *Radiology*.
372. Ude, Walter Herman, Minneapolis, Minn., *Roentgenology*.
373. Ulbrich, Henry L., Detroit, Mich., *Roentgenology*.
374. Upson, Wilbur Owen, Battle Creek, Mich., *Radiology*.
375. Van Allen, Harvey Ward, Springfield, Mass., *Radiology*.
376. Van Buskirk, Edmund Michael, Ft. Wayne, Ind., *Roentgenology*.
377. Velkoff, Metodi, Ft. Wayne, Ind., *Roentgenology*.
378. Virden, C. Edgar, Kansas City, Mo., *Radiology*.
379. Vogt, Edward C., Boston, Mass., *Roentgenology*.
380. Voke, Edward Lawrence, Akron, Ohio, *Diagnostic Roentgenology*.
381. Von Poswik, Gisela, Scranton, Pa., *Roentgenology*.
382. Walton, Henry Janney, Baltimore, Md. *Radiology*.
383. Wasson, W. W., Denver, Col., *Radiology*.
384. Waters, Charles A., Baltimore, Md., *Roentgenology*.
385. Watkins, W. Warner, Phoenix, Ariz., *Radiology*.
386. Weaver, Clarence E., Detroit, Mich., *Roentgenology*.
387. Webb, James A. H., Wichita, Kan., *Roentgenology*.
388. Weber, Harry Matthew, Rochester, Minn., *Roentgenology*.
389. Wescott, William Carter, Atlantic City, N.J., *Radiology*.
390. West, James H., Cleveland, Ohio, *Radiology*.
391. West, Theodore, Port Chester, N.Y., *Roentgenology*.
392. Whitlock, Simon Ben, Norfolk, Va., *Roentgenology*.
393. Widmann, Bernard Pierre, Philadelphia, Pa., *Radiology*.
394. Wigby, Palmer F., Dallas, Tex., *Radiology*.
395. Williams, Lester James, Baton Rouge, La., *Radiology*.
396. Willy, Ralph Gilmer, Chicago, Ill., *Roentgenology*.
397. Wilson, Stanley A., Burlington, Vt., *Roentgenology*.
398. Withers, Sanford, Denver, Col., *Therapeutic Radiology*.
399. Witwer, Eldwin Roy, Detroit, Mich., *Radiology*.
400. Wright, C. S., Indianapolis, Ind., *Diagnostic Roentgenology*.
401. Wurster, Lloyd Edward, Williamsport, Pa., *Diagnostic Roentgenology*.
402. Young, Barton R., Philadelphia, Pa., *Radiology*.
403. Zink, Oscar Charles, St. Louis, Mo., *Radiology*.
404. Zulick, J. Donald, Philadelphia, Pa., *Roentgenology*.

There will be two meetings of the Board in 1935 for the purpose of conducting examinations. The first will be in Yosemite, California, some time between May 10 and 15, and the second in Atlantic City, New Jersey, about June 8, 9 and 10. Any applicant wishing to appear before the Board in Yosemite must have his application in the Secretary's office not later than March 1, and anyone desiring to appear before the Board in Atlantic City must have his application on file by April 1, 1935.

The minimum requirements for eligibility to make application for a certificate are:

1. Membership in at least one of the national radiologic societies, the American Medical Association or the Canadian Medical Association.

2. At least three years' experience in radiology during which time not less than 75 per cent of the applicant's time has been devoted to radiology.

3. That the applicant does not hold or has not applied for a certificate from a specialty board, and that he does not list himself in the American Medical Directory or elsewhere as a specialist in some branch of medicine other than radiology.

4. That at least 75 per cent of the applicant's time is being devoted to radiology.

B. R. Kirklin, M.D.
Secretary-Treasurer,
The American Board of Radiology

BOOK REVIEWS

Books Received Are Acknowledged under Heading: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers as space permits.

MANUAL OF RADIOLOGICAL TECHNIQUE. By L. R. Sante, M.D., Professor of Radiology, St. Louis University School of Medicine; Radiologist to St. Louis City Hospital and St. Mary's Hospital, St. Louis. Paper. Pp. 157, with 141 illustrations. Ann Arbor, Michigan: Edwards Bros., Inc., 1934.

That extreme clarity and conciseness which Dr. Sante has always shown in his published articles is again dominatingly characteristic in his recently published Manual of Radiological Technique. This book is a distinct departure from the usual printing or mimeographing methods of publishing limited editions. This manual, according to the author, was designed to serve the radiologist whose task it is to train technicians, and to aid the technician and general medical profession. The lithoprinting makes the book more elastic and it is possible for any radiologist to eliminate any particular procedure which he does not desire, or to introduce additional regulations particularly applicable to his department. Space in the form of blank pages is provided for special instructions for those institutions or laboratories where certain special examinations are now routine or may later be included. A short historical chapter serves as an introduction and this is followed by chapters on physics written in a simple manner and easily understandable. The different types of tubes are described and illustrated. Adequate discussion is given of the physical properties of roentgen rays, calibration of machines and the essential factors in roentgenography. Roentgenographic procedures and dark room technique are covered fully with a suggestion to adopt and adhere to a definite routine performance.

All standard positions are illustrated with tube and part to be examined in proper position. The resulting roentgenogram from this position, and in many instances a diagram of the part examined, is included on the same page. Detailed description is given as to direction of the beam, position of the patient, essential equipment and the proper factors for use, viz., voltage, milliamperage, distance and time. A roentgenological consideration is summarized for each position and part examined and the advantages given for making the roentgenogram in that particular view.

Typewritten pages are lithoprinted in a reduced pica size corresponding very closely to 8 point type on a heavy grade of paper. The illustrations are made by the offset lithography procedure, reproducing the roentgenograms as negatives of uniform density and in good detail.

This manual will prove to be an excellent handbook and ready reference for technicians in developing a uniform technique for each part to be examined. If followed, the illustrated and printed directions should develop and standardize a technique so that it can be duplicated at a subsequent date. Such a book, in a short concise form, was needed by the busy roentgenologist in the teaching of technicians and Dr. Sante has produced it. A few typographical errors and mispelled words are found but these will no doubt be corrected in later editions. The table of contents could easily be elaborated upon which would increase the value of the book for quick ready reference.

S. W. DONALDSON

CLINICAL PATHOLOGY OF THE JAWS: WITH A HISTOLOGIC AND ROENTGEN STUDY OF PRACTICAL CASES. By Kurt H. Thoma, D.M.D., Charles A. Brackett Professor of Oral Pathology in Harvard University, Oral Surgeon to the Brooks Hospital, Consulting Oral Surgeon to the New England Baptist Hospital, etc. Cloth. Price, $9.00. Pp. 643, with 423 illustrations. Springfield, Illinois, and Baltimore, Maryland: Charles C Thomas, 1934.

This recently published volume is compiled from the results of extensive research in the pathological laboratory and study of cases from the private practice of oral surgery, together with a thorough review of the literature pertaining to the diseases discussed. The bibliographies appearing at the end of each of the twelve chapters demonstrate the very extensive review of the literature which the author has made.

In this book are discussed malformations of the head, face, and jaws; diseases, neoplasms and all other important types of lesions of the

jaws. Each subject is presented completely but at the same time concisely and it is not necessary to read many uninteresting words in order to glean the real information.

The pathological conditions discussed are abundantly illustrated by many excellently reproduced roentgen films, photographs and photomicrographs, as well as with case histories. The latter include history, clinical data, roentgen interpretations, diagnosis, treatment, pathological laboratory examinations and, in many cases, bacteriological laboratory findings.

Because of the many roentgenographic reproductions together with the interpretations, this book should prove to be of exceptional interest to the roentgenologist and more especially so because of the correlation of the roentgen readings with the surgical findings and pathological examinations. It may well be used for study by the student and reference by the practitioner and would be a valuable addition to the library of both.

H. F. Doane

Practical Talks on Heart Disease. By George L. Carlisle, M.D., Associate Professor of Clinical Medicine, Baylor University, Dallas, Texas. Cloth. Price, $2.00. Pp. 153. Springfield, Illinois, and Baltimore, Maryland: Charles C Thomas, 1934.

This book is written for the general man for, as the author believes, the practitioner has been given the wrong impression about heart disease by most teachers, as "he is made to believe that heart disease is a most difficult thing to diagnose and treat properly." While the reviewer, after a close contact of over twenty years with many medical teachers, has just the opposite opinion, nevertheless he will agree that any practitioner who thoroughly studies this book, which is easy to read and presents the facts in a simplified form, will have a good knowledge of heart disease. The author has chosen his material well, presents it in a readable style, and shows a very good grasp of his subject. It cannot hope to replace, however, many years of practical experience in managing patients with various types of heart disease.

There are a few statements which deserve criticism. A superficial reader might become confused regarding the dosage of digitalis as stated by the author. Some question after considerable experience the advisability of giving ammonium nitrate (or ammonium chloride) in large doses as a diuretic because of its tendency to produce gastrointestinal disturbances. Furthermore, the use of rest, digitalis and salyrgan will probably produce satisfactory results without the use of this drug. Although the intravenous use of salyrgan is advised, there is no warning that it should be given with great care for if even a small amount of the solution is accidentally injected around the veins, a slough will inevitably occur.

The reviewer does not know of any substantial proof of the following statement which is made on page 34 in reference to hypertension: "If the systolic pressure is proportionately higher than the diastolic, the patient is more apt to suffer some vascular accident such as apoplexy. If, on the other hand, the diastolic pressure is proportionately higher than the systolic, a cardiac breakdown will most probably result."

In general, it may be said that the author's idea in writing such a book is a commendable one, the field of heart disease is well covered, and the facts, with very few exceptions, are stated in an authoritative way. It is a book which can be recommended to students and practititioners.

C. C. Sturgis

La négativation électrique: Théorie, premiers résultats, cliniques. By P. Aubourg, Électro-radiologiste de l'Hôpital Beaujon, C. Laville, and P. Le Go. Paper. Price 20 fr. Pp. 146. Paris: Masson et Cie, 1934.

In this volume the authors discuss the place of extremely small doses in electrotherapy not with the idea of advocating them to the exclusion of other methods, but of pointing out their advantage when associated with general methods of treatment. In the first part Laville discusses the production of physiologic doses of electricity to supplement the deficiency necessary to bring the cellular metabolism up to normal, then Le Go describes in detail the beneficial action of small doses on the sympathetic system and then Aubourg discusses the results in a group of patients with neuralgias, neuritis, post-traumatic pain, and a group of fifteen cases of glycosuria which were presented at a conference at the Hospital Beaujon in May and June, 1933. This book contains some interesting information for those doing electrotherapy.

E. T. Leddy

DEPARTMENT OF TECHNIQUE

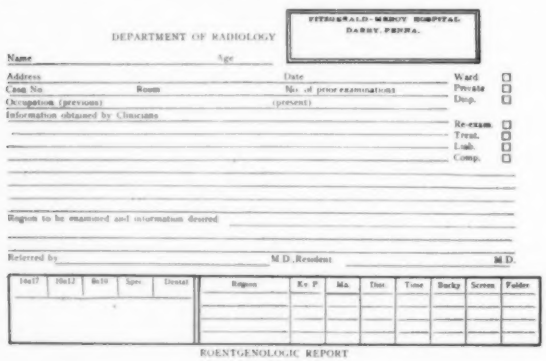
Department Editor: ROBERT B. TAFT, M.D., M. S., 105 Rutledge Ave., Charleston, S. C.

A SIMPLIFIED PRACTICAL METHOD OF FILM IDENTIFICATION

By WILLIAM R. STECHER, M.D.
PHILADELPHIA, PENNSYLVANIA

NO CLAIM is made as to originality in concept, but merely in design and development of a method of film identification as applicable to roentgenography; it requires no intricate and expensive apparatus, and can be performed speedily in the processing room. This principle has been employed by professional photographers for many years.

The undesirable features of the current methods of film marking, utilizing lead numbers and letters, are: (1) the appearance is generally poor; (2) the space required by the marking device is often excessive; (3) the marker is occasionally inadvertently misplaced upon an important region of the roentgenogram; (4) the site of the identification data is not uniform; (5) the marker is frequently lost or mislaid, which is a vexing item; (6) considerable time is lost in the replacing of the marker for each exposure, delaying an imperative rapid examination, such as during the examination of restless children and gastrointestinal roentgenography under roentgenoscopic control; (7) the patient's name or other desired data cannot be imprinted upon the roentgenogram as a permanent record.


DEPARTMENT OF RADIOLOGY

FITZGERALD-MERCY HOSPITAL
DARBY, PENNA.

Name _____ Age _____ Date _____

Address _____ Ward ☐
Case No. _____ Room _____ No. of prior examinations _____ Private ☐
Occupation (previous) _____ (present) _____ Disp. ☐
Information obtained by Clinicians _____
Re-exam. ☐
Treat. ☐
Lab. ☐
Comp. ☐

Region to be examined and information desired _____

Referred by _____ M.D., Resident _____ M.D.

14x17	10x12	8x10	Spec.	Dental	Region	Kv. P.	Ma.	Dist.	Time	Bucky	Screen	Folder

ROENTGENOLOGIC REPORT

FIG. 1. Request form. Note area allotted for identification data. Technique is recorded in region shown, immediately after or during examination. The report is carbon typed in the space provided, the original returned to the referring physician, and the form with complete data is pasted upon the filing envelope containing the roentgenograms, which then becomes a permanent record.

Adequate film identification includes: the name and location of the roentgenologic laboratory; the name, age and serial number of the patient; the date of the examination, and the initial of technician obtaining the roentgenograms. Occasionally, it is deemed advisable, for medicolegal reasons, to append the signature of the patient, which is duplicated upon the finished roentgenogram (see Fig. 3*b*).

The principle of the method advocated is direct contact printing of the identification data upon a radiation protected area on the corner of an exposed roentgenogram. This information is typed upon the designated area of the request form, as shown in Figure 1.

The contact printing device is graphically depicted in Figure 2, and consists of a rectangular aperture in the table top or film loading bench, upon which an ordinary glass slide is fitted. The size of the aperture should be slightly larger than the allotted area upon the request form. This measurement is accurately determined and the edges sharply delineated, by bordering the under surface of the glass slide with black latern slide binding. A small hinged compression device, the base of which is covered with felt, is of ample size both to cover the aperture of transmitted light, and aid in keeping the exposed film and

corner of the request form in close contact during a light exposure. The ledges act as guides for positioning the request form and superimposed film. The clips prevent shifting of the request form. This method of procedure enables rapid printing of many roentgenograms of the same patient, by merely superimposing the successive roentgenograms and making the respective light exposures. If a card system is employed, instead of ordinary paper request form, an indentation accommodating the card in the table top eliminates the clips. A ruby safe lamp constantly illuminates the aperture, thereby permitting visualization of the identification data on the request form.

The light exposure is made, with the request form and exposed film in firm contact, by pressing the push button, which is placed in series with the electric lamp. A small additional aperture covered by green celluloid enables visual recording of an exposure, inasmuch as the same lamp will illuminate this opening. The factors employed are as follows: 6 watt electric bulb at a distance of 20 inches from the aperture; time of exposure two seconds (this can be calculated by mentally counting "one-to-a-hundred"; "two-to-a-hundred," for a two second exposure, etc.). An inexpensive

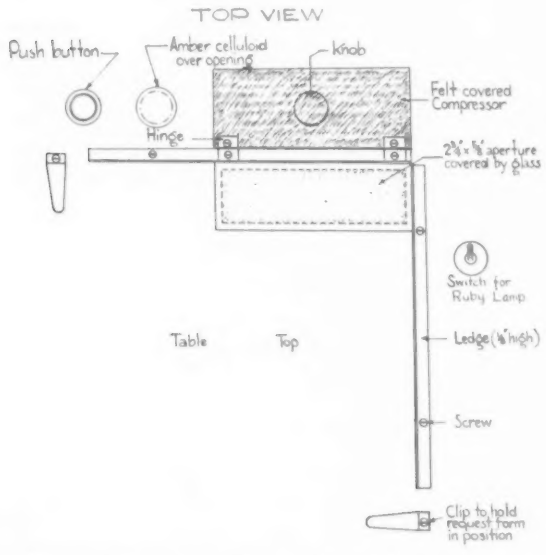


Fig. 2*a*. Contact printing device, for imprinting identification data on the roentgenogram.

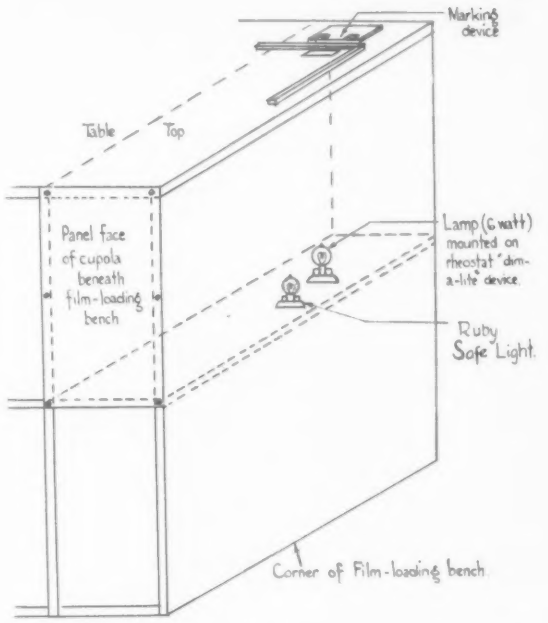

Marking device
Table Top
Panel face of cupola beneath film-loading bench
Lamp (6 watt) mounted on rheostat "dim-a-lite" device
Ruby Safe Light
Corner of Film-loading bench

Fig. 2*b*. Depicting corner of film-loading bench with marking device mounted on top. The one cupola is utilized as the light chamber, by enclosing with panel in the front. The electric lamp is placed in series with the push button or timer.

timer can be substituted for the push button, and thereby produce absolutely uniform exposures. This factor, however, is of no great importance, inasmuch as there is a permissible latitude from one to three seconds. The bulbs are enclosed in a light proof box, beneath one corner of the loading bench, as illustrated. A rheostat or inexpensive transformer type of "dim-a-lite" can be used to regulate the filament light, when the other factors are constant, thereby obtaining the optimum contrast on the roentgenogram. If an ordinary filing card with data imprinted upon it is adopted, then a 75 watt bulb should be substituted, with a two second exposure. The results are comparable to the paper request form method (see Figs. 3*a* and 3*b*).

The designated corner of the cassettes (the upper left hand corner in our own laboratory) has a rectangular lead sheet of 1/16 inch thickness imbedded beneath the aluminum or bakelite front, of dimensions slightly larger than the imprinted area on the request form, which

permits slight play of the film within the cassette. This is readily accomplished by elevating the chosen corner of the front intensifying screen and removing an identical size rectangle of felt beneath the cassette front, inserting the lead sheet in its place, and permanently fastening it in position by glue.

It is advantageous to insert at the same time a small lead number adjacent to the lead rectangle, which serves to identify the cassette. Sufficient space is allotted to permit of subsequent cutting of the corner of the roentgenogram without affecting the cassette number and identification data. The same procedure is adapted to the paper folders, the lead rectangle being glued upon the front of the same. It is an added advantage to identify the cassette by scribing the shielded area on the face of the cassette, and filling in the lines with white lead paint, which permits of rapid recognition for positioning of the cassette as a precautionary measure against superimposing an important area to be roentgenographed. The number of the cassette is similarly scribed in this area. A cassette without intensifying screens can be utilized for non-screen technique, and the rectangular lead sheet glued in position as stated above. The cassette front is likewise scribed and painted with red lead paint for identification purposes.

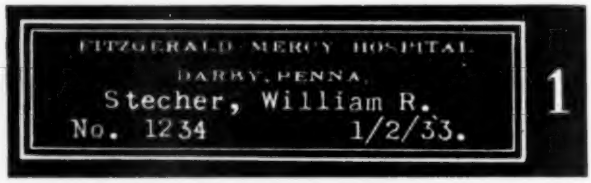


Fig. 3*a*. Replica from upper corner of finished roentgenogram, showing identification data. Note the imprint of the lead number 1 in the corner of the replica, which identifies the cassette employed.

Fig. 3*b*. Replica from roentgenogram in which the card request form was employed, showing good contrast obtainable. Also, the appended signature is shown as it can be utilized in medicolegal problems.

The following briefly summarizes the method advocated: The identification data desired are typed in the space provided on the request form, preferably with a dark black typewriter ribbon. The effect can be further intensified by placing a carbon paper on the reverse side of the paper permitting a simultaneous impression to be made. This procedure has been found to be unnecessary in routine work. The request form is positioned upon the exposure device, and fixed in position. The exposed roentgenograms are then removed from the cassettes and successively placed upon the request form, held in firm contact by the hinged device, while the exposures are respectively made by pressing the push button with the free hand. The procedure of removing the films from the cassettes so that the shielded area is in the upper right hand corner is practically fool-proof, inasmuch as the cassettes open only in the one direction, thereby orienting the technician. The films are then developed and the finished product will appear as illustrated in Figures 3*a* and 3*b*. A standard time-temperature method must be employed for consistent results.

I wish to thank Dr. B. P. Widmann and J. L. Weatherwax for their helpful suggestions in developing this procedure.

Vol. 33, No. 1

A "SHOCK-PROOF" THERAPY DRUM FOR THE LOWER VOLTAGES

By O. O. FEASTER, M.D.
ST. PETERSBURG, FLORIDA

THE factors that are particularly desirable in a tube holder for superficial and intermediate roentgen therapy are: (1) safety from high tension shock; (2) flexibility in positioning the tube so that any of the many areas to which roentgen radiation must be applied may be readliy approached; (3) protection of the operator from radiation; (4) long tube life, and (5) reasonable cost of the equipment.

The drum shown in the accompanying illustrations has been found, after use in several hundred treatments, to combine these features to a degree not attained in any other type of tube container in general use for therapy with the lower voltages. While no originality is claimed for any individual feature, it is believed that this assembly is sufficiently worth while to warrant reporting.

A patient, seated, having one hand treated, can, with some effort, reach high tension with the free hand but, with this single exception, the device is entirely "shock-proof" as concerns the patient.

Since the drum is readily raised and lowered and can be rotated on its own axis through an arc of 120° with ample electrical clearance, almost any area is readily approached. A patient is as easily treated when seated as when recumbent, which makes it convenient in scalp lesions and for areas on the face, neck and chest in individuals who are uncomfortable when forced to lie flat. In the installation illustrated, the same table is used for superficial, intermediate and deep therapy. The cone in position is 5 cm. long and when in contact gives a target-skin distance of 25 cm., with which at 110 kv. p. and 5 ma., without filtration, an erythema dose is given in three minutes.

The drum is shown attached by two steel rods to the deep therapy tube box. It is supported by cables attached to these rods about 10 inches from the trunnions, then passed over sheaves mounted on a shaft resting in boxes fastened to the deep therapy tube box near the ceiling, thence through the tube box to similarly mounted sheaves on the opposite side and down to a counterweight. A lead counterweight in the bottom of the drum compensates for the high tension bushings and other superstructure. The drum remains in any position without being locked and may be

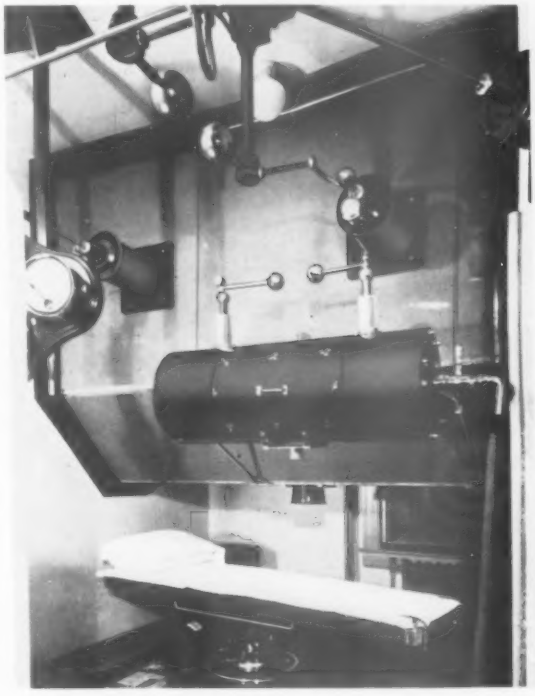


FIG. 1. In front of the deep therapy tube box is seen the superficial therapy drum partially raised. Immediately behind the ceiling lamp is one of the shafts to which sheaves are attached. The cathode cord reel is almost hidden by the meter panel at extreme left; the anode reel is above the right bushing. At the extreme right side is seen the flexible suction hose. The table has a hydraulic base and is mounted on a platform with large rubber-tired casters. The drum is grounded.

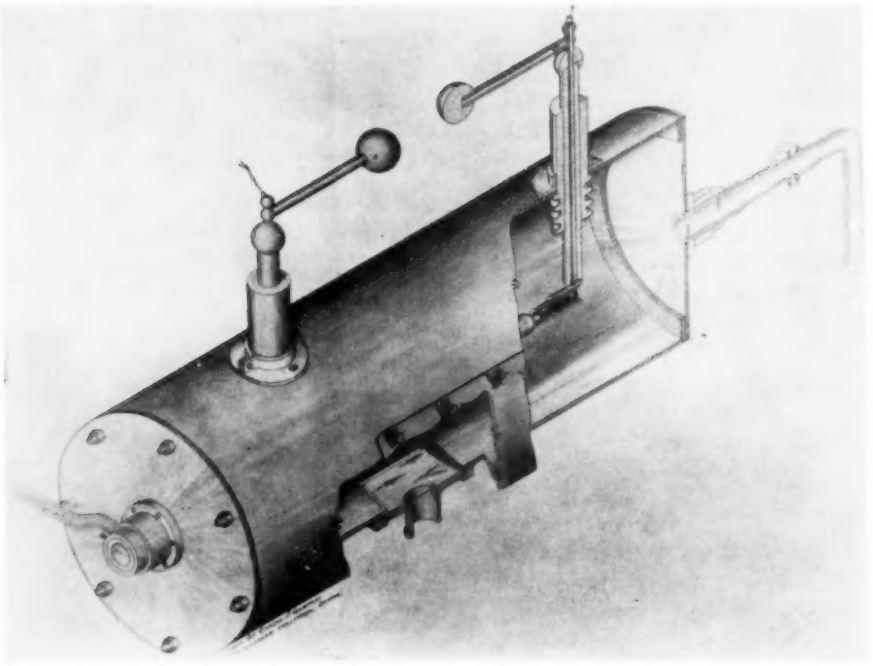


FIG. 2. Cutaway drawing showing left trunnion, left bushing, insulator and bushing clamp and a longitudinal section of the right bushing assembly.

raised, lowered or rotated with one hand, although it weighs nearly 300 pounds. When not in use it is raised as in Figure 1. Occupying no floor space, it is particularly adaptable to crowded quarters. Suspension from the ceiling, with the rods to a wall, would be as satisfactory as the method used here.

The Universal type Coolidge tube for which the cylinder is designed is ener-

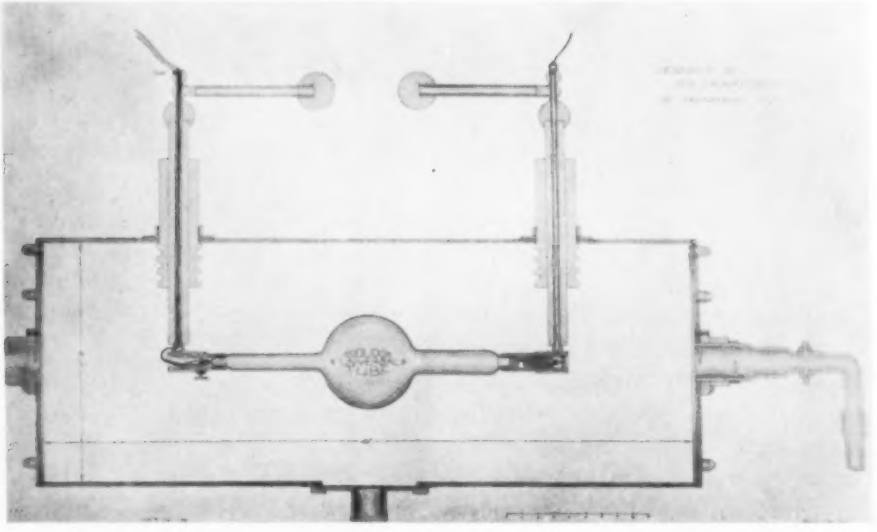


FIG. 3. A longitudinal section showing tube in situ. Air enters through left trunnion and escapes through the right to which is attached flexible hose leading to vacuum cleaner assembly.

gized from the deep therapy transformer. The high tension is connected by means of cord reels and the deep therapy tube left connected in parallel circuit, but with one side of its filament circuit broken, thereby obviating the necessity for installing a high tension switch capable of withstanding 200,000 volts. When it is desired to use the deep therapy tube the drum is disconnected and the deep therapy tube's filament circuit is restored by throwing a switch located on the back of the meter panel seen to the left in Figure 1.

The drum is constructed from $\frac{1}{8}$ inch boiler plate and is lined with $\frac{1}{8}$ inch sheet lead. The use of auto body metal would have been preferable to the boiler plate since it would have required less labor in preparing the surface to take a lacquer finish. A door which is held in place by thumb screws allows easy access to the interior for installing or cleaning the roentgen tube.

The spheres above the drum are set at 150 kv. p. to protect the tube from the accidental delivery of damaging voltages. The tube is cooled by a stream of air drawn through the drum by a vacuum cleaner assembly shown attached to the right end by flexible tubing. The ingress of air is through the left support. A square of safety roentgen film base is fastened under the filter box to insure proper circulation of air about the tube by preventing any intake at this opening.

The construction of the drum from sheet metal, the application of the lead lining, the manufacture of the bushing clamps, filter box, rods and trunnions and the nickel plating and lacquering were done in local shops. The porcelain bushings are from the stock room of the local power plant. The insulators inside the porcelain are varnished cambric (Empire cloth), wound on $\frac{3}{8}$ inch overhead tubing, glued as wound, then oven baked. They are of such diameter as to fit very snugly inside the porcelains. Actual test has shown that the assembly will operate at 140 kv. p. at 5 ma. The spheres, tube connectors and several other items are stock roentgen-ray parts, modified in some instances. The sleeve on the cathode end of the tube is secured by a thumb screw to insure a satisfactory filament circuit. The one on the anode end slides freely in its support to allow for variations in tube length resulting from temperature changes. These sleeves are also sufficiently adjustable to compensate for the differences in the lengths of Universal Coolidge tubes.

The entire cost of the drum, completed and installed, was considerably less than an ordinary tubestand and is vastly superior from almost every standpoint.

INDEX TO ABSTRACTS

ROENTGEN DIAGNOSIS

Head

WRIGHT, L. T., GREENE, J. J., and SMITH, D. H.: Diagnosis and treatment of fractured skulls 114
CARDILLO, F.: Study of encephalographic anatomy 114
PYRAH, L. N.: Chronic parotitis; a report of four cases with sialograms 114
INGBER, E.: Epithelioma of the pavilion of the ear and scirrhus of the stomach 115

Neck and Chest

KOHN, J. L., and KOIRANSKY, H.: Further roentgenographic studies of the chests of children during measles 115
MONTANARI, A.: The reality of roentgen images of peribronchitis and their morphological characteristics, particularly in the fibrous forms 115
BARNETT, L.: Hydatid pneumothorax 116
BÁRSONY, T., and KOPPENSTEIN, E.: The anatomical cardia that is visible roentgenologically 116
KUGEL, M. A., STOLOFF, E. G.: Dilatation and hypertrophy of the heart in infants and in young children 116
LICHTENBERG, H. H., and GALLAGHER, H. F.: Coarctation of the aorta 117
TYSON, RALPH M., and BOWMAN, J. E. Paralysis of the diaphragm in the new-born 118
JÖNSSON, G.: Roentgenological findings in malignant tumors of the nasopharynx 118
WORNING, B.: Roentgen examination of laryngeal and hypopharyngeal tumors 119
PRICE, L. W., and MOWAT, G. T.: A case of rapidly-growing carcinoma in the neck, arising in a parathyroid rest 119
CANNAVÓ, L., and COLA, G.: Roentgen appearance of bronchial spirochetosis 120
JONA, G.: Calcified form of brown induration of the lung 120
REICHLE, H. S.: Resolving exudates in pulmonary tuberculosis of childhood. Study II 120
PODESTA, V.: Roentgen appearance of sequels of pneumothorax 121
RUBIN, E. H., and NEWMAN, H. S.: Upper lobe bronchiectasis 121
WEINBERG, J. A.: Iodized oil in bronchiectasis, including a study of two cases following lobectomy 122
CHRISTOPHERSON, J. B.: The anatomy of chronic bronchitis and bronchial asthma as disclosed by lipiodol examination 122
SUNDBERG, C. G.: The roentgen kymogram of the normal heart 122
DYSON, J. M.: The radiologic recognition of heart disease in pneumoconiosis 123

Abdomen

ÅKERLUND, Å.: The anatomical foundation of the roentgenogram of the so-called "acquired hiatus hernias" 123
BIGNAMI, G.: Congenital diaphragmatic hernia 124
GIORDANO, M.: Roentgen diagnosis of an abdominal echinococcus cyst perforated into the small intestine 124
LENARDUZZI, G.: Congenital diverticulum of the stomach, functional diverticulum of the colon and pseudo-diverticulum of the gallbladder from congenital kink of its fundus in the same individual 124
BUISSON, M.: Diagnosis of multiple duodenal ulcers 124
CLARK, D. M., and GEYMAN, M. J.: Roentgen evidence of healing in duodenal ulcer 125
DE VEL, L.: Intestinal perforation with pneumoperitoneum in the new-born infant 125
COLOMBO, E.: A case of tuberculosis of the small intestine 125
VITA, G.: Roentgen investigation of the mobility of the colon 125
MASHERPA, F.: Roentgen diagnosis of calculi of the appendix 126
GUARINI, C.: Changes seen after hepatosplenography in leucemia 126
MCCLENDON, S. J.: Gallstones in children 127
DALL'ACQUA, V.: Improvement in the technique of oral cholecystography by means of fractional doses 127
MILANI, E.: Cholecystographic data in regard to strawberry gallbladder as shown by operative control 128
ANZILOTTI, A.: Interpretation of negative cholecystograms 128
YATER, W. M., and OTELL, L. S.: The differential diagnosis of diseases of the liver and spleen with the aid of roentgenography after the intravenous injection of thorium dioxide sol (thorotrast) 129

Genitourinary System

SANTORO, M.: Displacement of the cecum 129

Campbell, M. F.: Renal tuberculosis in juveniles 130
Swick, M.: Excretion urography 131
Kretschmer, H. L., Heaney, N. S., and Ockuly, E. A.: Dilatation of the kidney, pelvis and ureter during pregnancy and the puerperium 131
Lee, H. P., and Mengert, W. F.: The effect of pregnancy on the urinary tract 131
Giordano, M.: A case of large hydronephrosis clinically latent revealed by intravenous pyelography 132
Buisson, M.: Pain of the lumbosciatic type and changes in the urinary system 132
Hyams, J. A., Kenyon, H. R., and Kramer, S. E. Urethrocystography in the male 132
Gouverneur and Porcher: An accident of pyelography 132

Nervous System

Benassi, E.: Study of the routes of communication between the subarachnoid spinal spaces and lymphatic spaces of nerves. 133
Camp, J. D., Adson, A. W., and Shugrue, J. J.: Roentgenographic findings associated with tumors of the spinal column, spinal cord, and associated tissues 133

Skeletal System

Jeter, H., and McGehee, C. L.: Osteopoikilosis 134
Leopold, J. S., and Castrovinci, F.: Cleidocranial dysostosis 135
Platt, H.: On some complications of traumatic dislocation of the hip-joint 135
Snoke, P. O.: Vertebral epiphysitis and osteochondritis 136
Kleinberg, S.: Prespondylolisthesis: its roentgenographic appearance and clinical significance 136
Burman, M. S., and Sutro, C. J.: A study of the degenerative changes of the menisci of the knee joint, and the clinical significance thereof 137
Bistolfi, S.: Study of traumatic para-articular ossifications; paramalleolar ossifications .. 137
Vajano, D.: A case of solitary fracture of the posterior tibial process 137
Dodd, H.: Pied forcé or march foot 138

General

Swanson, W. W., Forster, W. G., and Iob, V.: Calcinosis circumscripta 138

ROENTGEN AND RADIUM THERAPY

D'Emidio, A. S.: Radium therapy of nasopharyngeal fibromas 139
Levin, S. J.: X-ray treatment of inflammatory conditions in childhood 139
Davis, A. A.: The treatment of Dupuytren's contracture 139
Tomlinson, C. C., and Bancroft, P.: Granuloma coccidioides 140
Feci, L.: Roentgen therapy of bone metastases of carcinoma of the breast 140
Camplani, M.: Five years' treatment of cancer by irradiation 140
Martin, H. E.: Radiation therapy in skin cancer 140
Fucci, N.: The value of roentgen irradiation of the hypophysis in diabetes mellitus .. 141
Haas, H.: A case of immediate death in Basedow's disease after roentgen irradiation .. 142
Evans, W. A., Jr.: Histological factors in the prognosis of mammary cancer treated by radical operation and x-rays 142
Busch, K. F. B.: Results of treatment of uterine cancer at the Aarhus Radium Center (Denmark) 142
Lauritzen, K.: Recurrences after five years cure in carcinoma of the cervix radiologically treated 143
Sharp, G. S.: Conservative surgical measures facilitating radium implantation 143
Sievert, R. M.: On protection against radiation in teleradium treatment 144

MISCELLANEOUS

Omizzolo, F. B.: "Standardized" technique in the roentgen examination of the respiratory tract 144
Santoro, M.: The injection of contrast fluid into fistulae 145
Lovisatti, N.: The influence of roentgen irradiation on the effects of adrenalin in rabbits 145
Capua, A.: Encephalomyelography with thorotrast 145
Angelo, L.: The decreased bactericidal power of rabbits immunized to typhoid bacilli and the effect on it of roentgen irradiation 146
Spinelli, A.: The hypophysis and fat metabolism 146
Rousthöi, P.: Angiocardiography 146
Thoraeus, R.: The protective power of lead rubber 146
Bloch, G., and Zanetti, S.: Preliminary note on attempts at angiopneumography 147
Benner, S.: Measurements of irradiation on roentgen workers 147
Griffith, H. D.: A test of some methods for calculating dosage in radium therapy 147
Thoraeus, R.: Ionisation measurements of the roentgen ray output from tubes at different voltages and with different focal distances 147
Moore, R. M., William, J. H., and Singleton, A. O., Jr.: Vasoconstrictor fibers ... 147
Furth, J., Seibold, H. R., and Rathbone, R. R.: Experimental studies on lymphomatosis of mice 148

ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

HEAD

WRIGHT, LOUIS T., GREENE, JESSE J., and SMITH, DAVID H. Diagnosis and treatment of fractured skulls. *Arch. Surg.*, Nov., 1933, *27*, 878–896.

The authors state that there is a newly acquired and much needed scientific interest in the study of fractured skulls and intracranial injuries. They report 347 consecutive cases giving the clinical data with discussion of the symptoms and physical findings. They discuss classifications, and the classification that they use at the present time is divided into two groups: (1) proved fractures of the skull and (2) proved intracranial injuries without fractures of the skull. In the first group the presence of a fracture was either demonstrated by the roentgen or post-mortem examinations. In the proved intracranial injuries without fractured skull blood in the spinal fluid was used as the confirmatory sign. They discuss the literature at length with regard to clinical diagnosis and treatment. It is interesting to note that acute alcoholism exists so frequently with injuries of the skull that in many instances the clinical picture is obscured irrespective of the degree of trauma. Head injuries were found most frequently in males, the incidence being 3 to 1. Automobile accidents were the most frequent cause of fractures. A table of the associated injuries is given which includes many of the other bones of the body.

In discussing the roentgen examination, the authors believe that it is one of the most important and their routine is to have roentgenograms made while the patient is in transmission from the admission office to the ward unless the patient is in shock. They state that the patient should be handled with extreme gentleness and exposures made by one skilled in taking roentgenograms of the skull. They make stereoscopic films of each side of the head which comprise 8 films in all. The only film that is omitted in the routine examination is the film of the base and they feel that this can be omitted as most fractures would extend up along the lateral aspect sufficiently to be demonstrated by lateral roentgenographic exposures.

The authors also state that encephalograms should be made in cases wherever possible in order to obtain information regarding permanent damage done to the brain and its coverings.—*E. P. Pendergrass.*

CARDILLO, FURIO. Studi di anatomia encephalografica. (Study of encephalographic anatomy.) *Radiol. med.*, Dec., 1933, *20*, 1525–1554.

The author studied the anatomy of the brain as shown by roentgenography after the introduction of air into the skull through the subarachnoid space in the lumbar or occipital regions, substituting it for the spinal fluid. More than 20 roentgenograms are reproduced and analyzed, the studies of the living subject being controlled by studies of the cadaver. In this way he tries to work out a normal picture and determine just what changes should be considered pathological and what their significance is. He concludes that while encephalography may in some cases be a valuable aid in diagnosis it is useless in many cases not only because the findings are apparently normal in cases in which there are undoubted organic lesions but also because there are almost unsurmountable difficulties in interpreting the roentgenograms. He does not consider this a reason, however, for abandoning the method in all cases of brain tumor as advocated by Vincent who thinks that only direct ventriculography should be used. He believes that it can be used effectively in some cases if only small amounts of air are insufflated. If small amounts of air are used the method is not dangerous.—*Audrey G. Morgan.*

PYRAH, LESLIE N., Chronic parotitis: A report of four cases with sialograms. *Brit. J. Surg.*, Jan., 1933, *20*, 508–515.

Sialography still remains an uncommon procedure in roentgenology. The author reports 4 cases with complete records and sialograms. The value of these sialograms is enhanced by the normal sialogram presented for comparison. The earliest deviation from the normal is demonstrated in a patient whose terminal ductules show small dilatations while Stenson's duct remained normal. Another sialogram pre-

sents a peripheral type of ductule sacculation very similar to the dilatation of bronchiectasis. The infection in this case was of longer duration. Chronic long-standing infection results in gland fibrosis which is indicated by an incomplete filling of the terminal ductules.

The symptoms of parotitis are reviewed and the possible occurrence of aerocele of the parotid is recalled by a case history. Treatment consists in removing all oral infections primarily. Gentle gland massage, acid drinks to stimulate secretion, and in resistant infections lipiodol and incision may be resorted to.—*P. J. Hodes.*

Ingber, Edmondo. Epitelioma del padiglione auricolare e scirro dello stomaco. (Epithelioma of the pavilion of the ear and scirrhus of the stomach.) *Arch. di radiol.*, 1933, *9*, 418–432.

A case is described in a man of sixty-five who came for treatment in August, 1930, for a tumor of the pavilion of the right ear which had begun to develop about a year and a half before. It had grown to about the size of a hazelnut and ulcerated. Microscopic examination of a piece excised from the tumor showed epithelioma. The patient returned home without taking the roentgen treatment which was advised. He returned in March, 1931, and was given roentgen treatment. In June he began to complain of a feeling of weight in the stomach; he had lost weight and was unable to work. There was slight pain on palpation in the epigastric region. Roentgen examination showed a small stomach with rigidity of the distal half. The picture was that of a scirrhous carcinoma of the antral part of the stomach. The patient left the hospital and died in December of that year.

The author discusses the question of whether the stomach cancer was a metastasis of the cancer of the ear or whether the two tumors merely coexisted. He is unable to settle the question as neither operation nor autopsy was performed.—*Audrey G. Morgan.*

Kohn, Jerome L., and Koiransky, Henry. Further roentgenographic studies of the tests of children during measles. *Am. J. Dis. Child.*, July, 1933, *46*, 40–58.

Authors' Summary.

1. Roentgenograms of the chests of 59 children between the ages of one and ten years were taken in various stages of measles. Lateral as well as posteroanterior positions were used in taking the roentgenograms.

2. Using the lateral position, enlargement of the lymph nodes localized in front and below the bifurcation of the trachea and occasionally of those in the posterior mediastinum was found in nearly every case. The maximum enlargement of the lymph nodes was seen most frequently during the height of the eruption.

3. With the lateral position there was evidence of a pleural involvement in 11 cases. This was usually shown by a visibility of interlobar fissures between the various lobes.

4. With the lateral position the enlarged lumph nodes were present irrespective of the presence or absence of roentgenographic evidence of pulmonary infiltration. The size of the roentgen opacities caused by the lymph nodes decreased even if the pneumonic process was progressive.

5. Confirming our previous observations during measles, pulmonary infiltrations, enlarged hilus shadows, increased intensity of the pulmonary markings and pleural changes were again found. These findings were frequently present in mild as well as in severe cases.

6. Shadows suggesting pulmonary infiltrations were found in 15 of 23 patients under one year of age.

7. The roentgenograms of the chest taken during measles showed pulmonary infiltration in only 4 of 17 patients receiving immune serum after exposure to measles. One gets the impression, therefore, that children receiving immune serum soon after exposure to measles are less likely to have pulmonary infiltrations.

8. Even in the patients who received serum and did not show pulmonary infiltrations, enlarged hilar shadows and increased intensity of the pulmonary markings were found.

9. Studies of roentgenograms, taken at necropsy, of children who died of measles give a clearer conception of the pathologic process.—*R. S. Bromer.*

Montanari, Arrigo. Sulla reale esistenza delle immagini radiologiche dovute alla peribronchite e sui loro caratteri morfologici, in particolare modo delle forme fibrose. (The reality of roentgen images of peribronchitis and their morphological characteristics, particularly in the fibrous forms.) *Radiol. med.*, Nov., 1933, *20*, 1362–1369.

There has been a tendency on the part of

some authors recently to deny the existence of peribronchitis in tuberculosis. But the author maintains that there are not only clinical evidences of such a condition but also incontestable roentgen proofs of it. In the fibrous form of peribronchitis particularly there are characteristic opaque tracts ending in dark rings surrounding a clearer space. The clear space represents the lumen of the bronchus. These may occur not only in the region of the hilus but in other parts of the lung, particularly at the apices and at the periphery. They may occur not only in the fibrous form of tuberculosis but may be seen in the forms with productive and exudative infiltration. At the apices these little rings are sometimes arranged in groups or "bouquets" which give a very characteristic appearance.—*Audrey G. Morgan.*

BARNETT, LOUIS. Hydatid pneumothorax. *Brit. J. Surg.*, April, 1932, *19*, 593–600.

Approximate'y 10 per cent of the hydatid cysts occurring in the human body are found in the lungs. Many of these are located deep in the pulmonary substance, and before they are very large rupture into a main bronchus, bringing about a spontaneous cure in 80 per cent of cases. Those peripherally located may grow very large in the course of years, and sooner or later undergo complications and cause serious troubles. The complication of pneumothorax due to the rupture of a pulmonary cyst into the pleural cavity with coincident opening into a bronchus is decidedly uncommon.

One should have no difficulty in diagnosing the hydatid factor of a hydro- or pyopneumothorax if only its possibility is kept in mind. More often than not, the true pathology of hydatid pneumothorax is not recognized until the patient has actually coughed up his own diagnostic label, or else the condition is recognized at operation or autopsy. The skin reaction of Casoni and the blood complement deviation test are of valuable assistance in arriving at the proper diagnosis.

Operation is the treatment.

The author gives a detailed and interesting history of a sheep farmer with hydatid pneumothorax.—*W. C. Hall.*

BÁRSONY, THEODOR, and KOPPENSTEIN, ERNST. Die röntgenologisch sichtbare anatomische kardia. (The anatomical cardia that is visible roentgenologically.) *Acta radiol.*, 1933, *14*, 335–343.

The ideas formerly held in regard to the anatomy, physiology and pathology of the esophageal opening in the diaphragm, the intra-abdominal part of the esophagus and the cardia have recently undergone considerable change. It was formerly taught and generally accepted that the esophagus after passing through the esophageal opening in the diaphragm bends to the left and after an intra-abdominal course of 2-4 cm. empties into the stomach. The esophageal opening was considered only a physiological constriction. Recently, however, different opinions have been expressed in regard to the intra-abdominal part of the esophagus, the function of the cardia and the esophageal opening. It has been asserted that in many cases the esophagus has no intra-abdominal part, that the cardia plays no part or at most only a subordinate one as a sphincter muscle and that the closure between the stomach and esophagus is affected entirely or chiefly by the diaphragm. These theories disagree not only with the old generally accepted one but also to a certain extent with each other. The authors review some of the leading opinions on the subject and conclude that the views recently expressed in regard to the roentgenology of the cardia are mistaken. The roentgenograms described by Palugyay as representing the visible mechanism of the cardia do not represent the cardia at all but the intra-abdominal part of the esophagus. The normal cardia cannot be demonstrated roentgenologically by any means at present available. It can be demonstrated under some pathological conditions including: (1) hernias of the opening, (2) certain functional constrictions of the cardia and (3) certain postoperative stomach changes.—*Audrey G. Morgan.*

KUGEL, M. A., and STOLOFF, E. GORDON. Dilatation and hypertrophy of the heart in infants and in young children. *Am. J. Dis. Child.*, April, 1933, *45*, 828–864.

The authors report 7 cases of their own and in addition thoroughly review the literature, collecting 52 cases of congenital idiopathic hypertrophy. From the uniform pathologic changes in the myocardium observed in their cases, they arrive at the following conclusions:

First, true congenital idiopathic hypertrophy is an extremely rare condition, only 17 cases having been found in the literature which they considered actually in this group. The first case they encountered was felt to be pure

idiopathic hypertrophy, because the first few microscopic slides showed only simple hypertrophy of the muscle bundles. However, when the hearts were examined by the sections along the coronary arteries and by standardized sections according to the recommendations of Gross, Antopol and Sacks, myocardial degeneration and fibrosis were found in all their own cases; vascular lesions were present in most of them and in 2 there were lymphocytic infiltrations. (The sections taken by Gross and Sacks include all the valves, the left and right auricles, the left and right ventricles, the interventricular septum and the papillary muscle.)

Secondly, it is obvious that unless thorough microscopic as well as gross examination is made, cases cannot be included with the group of so-called idiopathic hypertrophy. In view of the fact that children with this condition die suddenly of cardiac failure, it seems *a priori* peculiar to find hearts normal except for some hypertrophy of the muscle. This group of so-called idiopathic hypertrophy may be simulated by other conditions. Thus a case of so-called idiopathic hypertrophy was associated with congenital medial sclerosis of the coronary arteries as reported by Kissane and Fidler. (Other instances of this sort are also cited.)

Thirdly, congenital idiopathic hypertrophy of the heart, if such a condition actually exists, can only be diagnosed if, after a careful examination of the heart grossly and microscopically, one finds an increased weight associated with simple hypertrophy of the muscle fibers. In making a diagnosis of so-called idiopathic hypertrophy of the heart, the following conditions must be excluded: (1) Congenital defects of the heart; (2) abnormal origin of a coronary artery from the pulmonary artery; (3) lesions of the kidney, nephritis etc.; (4) pulmonary lesions such as syphilis, extensive chronic involvement etc.; (5) anemias of long standing (secondary anemia, leucemia, etc.); (6) infections or suppuration of the heart, rheumatic fever, suppurative and bacterial endocarditis; (7) congenital medial sclerosis of the coronary arteries; (8) microscopic evidence of degeneration of the myocardium; (9) clinical history of hypertension; (10) history of avitaminosis such as beriberi, and (11) clinical history of infections, diphtheria, etc. All these conditions are known to cause myocardial disease.

Kugel and Stoloff believe that if all the cases of enlargement of the heart in infants were carefully studied on the above basis, the group of so-called congenital idiopathic hypertrophy would dwindle and perhaps eventually disappear. The distinction from the term so-called congenital hypertrophy is not merely an academic question. When it is realized that an actually diseased heart muscle and not hypertrophy must be dealt with, that a markedly enlarged heart in an infant is a serious matter, then the treatment of this apparently highly fatal condition may be more effective.

They report striking results of the roentgen examinations in their own cases. There was an enormous enlargement of the heart both to the left and to the right and in the vertical direction. The enlargement, however, is predominant on the left side. It may be so marked as to fill completely the left side of the chest in its transverse diameter. The value of the roentgen examination in unexplained dyspnea and cyanosis becomes apparent since it may reveal a pronounced enlargement of the heart, frequently in the absence of physical signs. Although the roentgen appearance is strikingly suggestive of this condition, it is by no means characteristic, since a similar shadow may be cast in dilatation and hypertrophy associated with valvular disease, in congenital anomalies and occasionally in association with marked anemia and severe rickets. The left auricle is not usually enlarged, and the murmurs of mitral stenosis are lacking. However, in infancy and in the second year of life, during which periods most cases of so-called idiopathic enlargement are found, vegetative endocarditis and rheumatic disease are relatively rare. Congenital anomalies frequently reveal their presence by suggestive and constant murmurs. The finding therefore, of enormous dilatation and hypertrophy associated with cyanosis and dyspnea of sudden onset, in the absence of murmurs which are suggestive of congenital malformation, should be suggestive of so-called idiopathic hypertrophy. The value of the roentgen examination, the authors state, lies in the fact that it brings to light evidence pointing to the cardiac involvement when clinically there may not be evidence thereof. Thus percussion may be normal, the murmurs absent and heart sounds may not appear abnormal.—*R. S. Bromer.*

Lichtenberg, H. H., and Gallagher, H. F. Coarctation of the aorta. *Am. J. Dis. Child.*, June, 1933, *45*, 1253–1262.

The authors report a case of coarctation of

the aorta, basing their diagnosis on the three cardinal symptoms of this condition: (1) hypertension in the arms with the blood pressure in the lower extremities unattainable, (2) absent pulsations of the abdominal aorta and arteries of the legs and (3) an extensive collateral circulation manifested by forcibly pulsating, dilated arteries in the neck and thorax. The diagnosis was further confirmed by the roentgenograms, which showed a marked "scalloping" of the ribs, due to the corroding action of the enlarged and tortuous intercostal arteries. Neither in the roentgenograms nor by roentgenoscopic examination were they able to visualize the entire aortic arch. Fray considers this of diagnostic importance in coarctation.

Their patient was a white girl aged twelve, who had been apparently well until two months before her admission to the hospital when she suddenly became dizzy while playing in the school yard. Vomiting occurred several times during the fifteen minutes following the onset of the attack. When brought home she had a high fever, which remained elevated for two weeks. From the onset she had a marked weakness of the left arm and leg. After four weeks she was out of bed but the weakness in the arm and leg presisted. For two weeks she again felt well when she had a convulsive seizure, suddenly becoming dizzy, followed by falling on the floor and was found unconscious, with her eyes rolled upward and both arms extended and twitching. After this seizure she had been out of bed and felt well except for fairly frequent dizzy spells, and frontal headaches that were relieved by lying down. On physical examination she had a typical hemiplegic gait, the left arm and leg were decidedly weak. There were marked ataxia and adiadokokinesis of the left side. The deep reflexes were also increased on this side. Sensation was normal throughout. Since her admission to the hospital the patient has been under observation for eighteen months. Lichtenberg and Gallagher believe that the patient's symptoms are due to an intermittent leakage of a cerebral aneursym, probably in the right rolandic area, which has not led to a fatal temination during the period of observation. They could find no record in the literature of a similar condition diagnosed during life. In none of the cases collected by Abbott nor in those reviewed by the authors was there a report of a recovery following a hemorrhage.—*R. S. Bromer.*

TYSON, RALPH M., and BOWMAN, JAMES E. Paralysis of the diaphragm in the new-born. *Am. J. Dis. Child.*, July, 1933, *46*, 30–39.

Tyson and Bowman report 5 cases of paralysis of the diaphragm in the new-born and add 8 more cases collected from the literature. The cause of the condition is injury to the phrenic nerve by obstetric manipulation. The physical signs are cyanosis, irregular respiratory rate and rhythm usually appearing the first few days after delivery. Usually there is an accompanying brachial paralysis. The prognosis is good in regard to life; the mortality as reported is 16 per cent.

The roentgenogram and especially the roentgenoscopic examination give absolute proof of the presence of the condition. Films show a high diaphragm and areas of atelectasis on the affected side, and the heart is displaced toward the affected side. Roentgenoscopy reveals the diagnostic or paradoxical "see-saw" movement, sometimes called the Kienböck phenomenon. In this, the paralyzed side ascends during inspiration and descends during expiration, while the unimpaired side pursues normal excursions. Also there can be observed under the roentgenoscope a to-and-fro movement of the mediastinal contents with the respiratory cycles.

Paralysis of the diaphragm should be suspected in every new-born baby with brachial paralysis, especially if there is accompanying respiratory embarrassment. All such cases should be studied under the roentgenoscope, and if the condition is present, the diagnostic see-saw movement will be observed.

Little can be done for babies with paralysis of the diaphragm besides general supportive measures and careful feeding. Those who recover show slow recovery from the major symptoms, although evidence of faulty action of the diaphragm may be present during the first year. It was seen that infants with this condition are more susceptible to respiratory infection.—*R. S. Bromer.*

NECK AND CHEST

JÖNSSON, GUNNAR. Roentgenological findings in malignant tumors of the nasopharynx. *Acta radiol.*, Feb., 1934, *15*, 1–7.

The clinical diagnosis of malignant tumors of the hypopharynx is often difficult and roentgen examination is very important in such cases. Some of these cases do not cause any

symptoms until the tumor has invaded the nerves along the base of the skull or has penetrated the middle cranial fossa.

Thirty-three cases of malignant tumor of the hypopharynx have been examined roentgenologically at the Serafim Hospital during the last three years. In 4 of these cases clinical diagnosis was impossible. Histories are given of a number of typical cases and the roentgenograms are reproduced.

Zuppinger advocates the introduction of lipiodol into the nasopharynx to demonstrate the tumors but the author has found air contrast sufficient. The axial roentgenogram is generally sufficient for diagnosis but in doubtful cases a lateral view should be taken. Tumors of the lateral walls of the nasopharynx show best on the axial films, those of the roof and posterior wall can be seen most clearly on the lateral roentgenogram. Lateral roentgenograms are taken in a sitting position with a focus-film distance of 2 meters, 80 kv., 150 ma., and an exposure time of 0.3 to 0.4 seconds. In order to increase the size of the air-filled cavity and improve the contrast the patient may force air into the upper air passages while keeping the mouth and nostrils closed. Other roentgenograms are taken on Lysholm's skull table by the method he has described for the examination of the skull.

Mayer reports a difference in the destruction at the base of the skull caused by carcinoma and sarcoma. No such difference could be seen in this material either between the different types of cancer or between them and the lympho-epitheliomas. Although destruction of the base of the skull of the type seen in these roentgenograms is usually caused by malignant tumors of the nasopharynx, similar changes may be caused by intracranial tumors. Some cases of hypophyseal tumor have caused similar changes. But in cases in which there is destruction of the base of the skull and a tumor shadow in the nasopharynx and no roentgen evidence that the destructive process began in the cranial cavity a diagnosis of tumor of the hypopharynx can be made safely.—*Audrey G. Morgan.*

Worning, Börge. Roentgen examination of laryngeal and hypopharyngeal tumors. *Acta radiol.*, Feb., 1934, *15*, 8–23.

At the Finsen Institute and Radium Center in Copenhagen roentgen examinations have been made in 50 cases of laryngeal and hypopharyngeal tumors since 1931. The results in most cases have agreed with those of laryngoscopy. Neither of the two methods alone is adequate but they supplement each other very effectively. Roentgenograms interpreted on the basis of laryngoscopy are very valuable. They give information in regard to the lower boundary of the growth of the tumor, the extent of its growth into the region back of the larynx and any recurrences there, and show destruction of the laryngeal cartilages. Tumors of the larynx and hypopharynx are manifested in the roentgenogram chiefly by projection into the lumen of those organs, by dislocating the larynx and by destroying the laryngeal cartilages.

With reference to technique, at the Finsen Institute the cassette is placed in front of the shoulder for the lateral projection with the lower edge of the frame 4 or 5 cm. below the rounding of the shoulder. A focus-film distance of 175 cm. is used to avoid errors of proportion and for the sake of greater sharpness. The greater distance also has the advantage of decreasing the secondary radiation of the film. The patient is placed sideways on an ordinary chair as for lung examination with his head supported by a couple of soft pillows, the shoulders well back, the neck stretched and the head bent slightly backward. The head must be held at a right angle to the shoulders and the radiation directed at a right angle to the neck so that the two halves of the larynx cover each other as completely as possible. In this way the roentgenogram includes the trachea as far down as the upper opening and, as a rule, the first thoracic vertebra. Two lateral pictures are taken of each case and also a ventrodorsal view and a lateral view while a mouthful of barium paste is being swallowed. The exposure time varies from three-fourths of a second to a second, with 40 ma. and 60 kv.

Twelve cases are described and illustrated with roentgenograms.—*Audrey G. Morgan.*

Price, L. Woodhouse, and Mowat, G. T. A case of rapidly-growing carcinoma in the neck, arising in a parathyroid rest. *Brit. J. Surg.*, April, 1932, *19*, 645–650.

The tumor described in this paper is believed to have arisen in parathyroid tissue, and, from its site of origin, to furnish evidence of the occurrence of aberrant tissue of this nature above the level of the greater cornua of the hyoid bone. Supernumerary parathyroids in relation to the thyroid gland are not uncommon, and developmentally the occasional per-

sistence of such aberrant tissue might reasonably be expected to be found at any point along the course of descent of the parathyroids. Embryologically, it is generally agreed that the upper parathyroid arises in the fourth visceral cleft close to the thymic bud which arises in the same cleft. The lower parathyroid arises with the thymus in the third visceral cleft and descends on the dorsal aspect of the thymic pouch from the region behind the future posterior pillar of the fauces to its adult position behind the lower pole of the thyroid gland. It is more than conceivable, therefore, that fragments of parathyroid tissue could be found as "rests" or that a complete parathyroid gland could be found arrested along the course of its descent. From such a "rest," or from such an arrested lower parathyroid gland, situated above the level of the greater cornua of the hyoid bone, the authors believe the tumor described in the article to have arisen.

Clinically, in the case reported, the course of the disease proved rapidly fatal, as the rate of growth of the tumor and of the development of metastases was very great. Nevertheless, at no stage when this case was under observation could any signs of hyperparathyroidism be demonstrated. Roentgen examination of the skeleton did not reveal any rarefaction of the bones. Repeated estimations of the blood calcium always gave readings below 10 per cent.

Histologically, this tumor appeared to resemble a malignant parathyroid rather than a carotid-body tumor or a hypernephroma.—*W. C. Hall.*

CANNAVÓ, L., and COLA, G. Gli aspetti radiologici della spirochetosi bronchiale. (Roentgen appearance of bronchial spirochetosis.) *Radiol. med.*, Dec., 1933, *20*, 1554–1567.

Spirochetosis of the bronchi is not unusual in Sicily and the authors have had occasion to study a number of cases. The most marked characteristics of the early cases, which constitute about 60 per cent of the whole number are: (1) The process is limited to the bronchi, the lung parenchyma not being affected, and is almost entirely in the region of the hilus. (2) Moniliform bronchiectases can be seen along the course of the bronchi. These can be seen better by means of bronchography with iodized oil than by ordinary roentgenography. (3) Marked congestion of the pulmonary vessels. (4) Hypertrophic and fibrous lymph glands. (5) Absence of calcification. (6) A tendency to fibrosis and sclerosis of peribronchial origin.

In later cases there is sclerosis of the apex and still later diffuse interstitial sclerosis with emphysema and retraction of the thorax. Later the pleura may become involved and cases with abscess formation in the lung parenchyma have been seen. These can no longer be differentiated roentgenologically from other forms of lung abscess.

The diseases from which differential diagnosis is necessary are chronic bronchitis, syphilis, mycosis and tuberculosis. The differential signs are discussed. The clinical signs and sputum examination must be made use of to supplement roentgen differentiation.—*Audrey G. Morgan.*

JONA, GIUSEPPE. Induramento bruno del polmone a forma calcificante. (Calcified form of brown induration of the lung.) *Radiol. med.*, Dec., 1933, *20*, 1521–1525.

A case of brown induration of the lungs of the calcifying type is described in a young man of twenty-nine who had had serious mitral stenosis for ten years with repeated hemoptysis. He died from insufficiency of the myocardium.

About a year before death a roentgenogram had shown many round shadows the size of pinheads, chiefly in the lower lobes, more on the right side than on the left and none in the apices. They were at that time interpreted as foci of condensation caused by the accumulation of blood cells from the repeated hemorrhages. On autopsy, the lungs showed the typical picture of brown induration of the lungs and a roentgenogram showed the round foci from the size of pinheads to that of peas. They had undergone calcification in the meantime. The roentgenograms taken a year before death and after death are reproduced, showing that the stages of such processes can be followed up by roentgen examination.—*Audrey G. Morgan.*

REICHLE, H. S. Resolving exudates in pulmonary tuberculosis of childhood. Study II. *Am. J. Dis. Child.*, 1933, *46*, 969–989.

In the first part of Reichle's work, previously published, he discussed the pathologic character of the resolving exudates in pulmonary tuberculosis of children. In this second part he presents clinical and roentgenological records in support of the ideas developed in Study 1, first, that extensive exudates in the pulmonary tuberculosis of children do resolve completely,

and, second, that it is impossible to differentiate from the mode of onset and physical signs whether a given lesion will result in complete recovery or an extension of the disease process and death.

His conclusions follow:

1. The lobar infiltrations in the course of pulmonary tuberculosis are largely tuberculous pneumonias.

2. It is not possible to differentiate at an early stage between the resolving exudates of pulmonary tuberculosis and caseous pneumonia.

3. The term resolving exudate and all of the other terms that have been used for the same condition express not diagnosis, but prognosis.

4. There are no certain guides for early prognosis. Only the observation of a child over an extended period of time permits one to venture a dependable opinion.—*R. S. Bromer.*

Podesta, Vittorio. Alcune considerazioni sugli esiti da pneumotorace in rapporto al loro aspetto radiologico. (Roentgen appearance of sequels of pneumothorax.) *Arch. di radiol.*, 1933, *9*, 529–551.

One of the first effects of pneumothorax is to cause a new formation of connective tissue as a result of which the pathological foci are surrounded and interpenetrated with fibrous tissue. Also the presence of the gas, which to a certain extent injures the endothelium, provokes an exudative pleurisy with more or less effusion. After pneumothorax there may be all stages of this reaction from a simple increase in thickness of the parietal and visceral folds of the pleura to a true productive plastic pachypleurisy which appears in the roentgenogram as a more or less uniform zone of opacity contrasted with the clearer area of the collapsed lung. A real shell of pleural induration may be formed which encloses the gas or the pleural effusion and keeps the lung compressed. The fibroplastic process may occur without an effusion. It may begin in any part of the pneumothorax area but is more apt to begin where there is some pleural adhesion.

The author describes and illustrates with roentgenograms 10 cases of this condition which is called opaque pneumothorax by some authors and by others paradoxical roentgenogram in pneumothorax complicated by adhesive pleurisy. He says the former designation is not correct because an opaque pneumothorax would really be the picture furnished by the introduction of an opaque gas while here the opacity is caused by the plastic pleurisy or in some cases by the effusion. Neither is the term paradoxical roentgenogram correct for there is nothing paradoxical about a denser shadow being given by a hard shell of thickened pleura than by lung tissue which though collapsed still contains some air. He suggests using the term pleural induration from pneumothorax or metapneumothoracic pachypleuritis, which really describes the process.—*Audrey G. Morgan.*

Rubin, Eli H., and Newman, Harry S. Upper lobe bronchiectasis. *Am. J. M. Sc.*, Nov., 1933, *186*, 650–659.

The authors present a series of cases which they had studied at post mortem. In their opinion bronchiectasis limited dominantly, or entirely, to one or both upper lobes of the lungs is not so rare a condition as might be thought, considering the scant mention it receives in the literature. Indeed, they say that individuals who give a history of cough and expectoration for a number of years, without symptoms or signs of pulmonary neoplasm and who, on roentgen examination, reveal upper lobe involvement, should be suspected of having bronchiectasis, provided of course that the sputum does not contain tubercle bacilli.

In the majority of instances there seemed to be a close relationship between bronchiectasis and an old healed tuberculosis. It was most unusual, however, to find evidence of active acid-fast infection at necropsy. The pulmonary fibrosis and shrinkage causing traction and dilatation of the bronchi might have been influenced, in part at least, by secondary invasion of the deeper bronchial layers.

The clinical diagnosis of upper lobe bronchiectasis can only be made after long and careful study, being certain to rule out tuberculosis of course. Symptomatically, patients with upper lobe bronchiectasis present the picture of chronic fibroid phthisis. Increasing dyspnea and weakness, subnormal temperature, blood spitting or frank hemorrhage are frequent and characteristic. Profuse expectoration, fetid breath, clubbing of the fingers and bouts of fever are unusual when the upper lobes alone are involved.

In upper lobe bronchiectasis signs of apical shrinkage are often lacking—an unusual occurrence in tuberculosis. This may possibly be due to the fact that the largest dilatations of the bronchi are frequently situated subpleurally and the coexistence of large emphysematous

blebs gives a resonant or tympanitic note on percussion. Occasionally the Potter-Bucky diaphragm helps in identifying the small circular areas or rarefaction under the pleura. Another very important point in the differential diagnosis is that, in spite of increasing symptoms, comparative films, even after a lapse of several years, may show surprisingly little change.—*P. J. Hodes.*

WEINBERG, JOSEPH A. Iodized oil in bronchiectasis, including a study of two cases following lobectomy. *Arch. Surg.*, Sept., 1933, *27*, 545–564.

This article reports the examination of lung tissue removed from 2 patients suffering from bronchiectasis. These patients had been treated with iodized poppy seed oil previous to operation. The studies made of experimental work upon animals whose lungs were instilled with iodized oil are also reported.

The microscopic study showed that not only the large mononuclear phagocytes took up the oil, but that all the cells ingested it. It was noted that oil was present in large amounts eighty-three days after bronchial instillation. The distribution of the oil was quite patchy throughout the diseased lung.

The first animal experiments were done by injecting 1 c.c. of oil into the exposed trachea of guinea pigs. The animals were killed at intervals of four to twenty-eight days and sections made of the lung tissue. These studies showed multiple areas of atelectasis apparently due to the plugging of the bronchi and bronchioles. These areas were surrounded by an inflammatory reaction. The oil droplets were quickly taken up by the tissue and at times remained in the alveolar walls and at other times were transported some distances.

The second series of animal experiments consisted of ligating a lower lobe bronchus with absorbable material. These animals developed a condition in the lobe supplied by the obstructed bronchus comparable to bronchiectasis. Iodized oil was later injected into the trachea and the animals killed six to sixteen days following the injection. The greater part of the oil was found in the diseased lung which was abscessed and adherent to the parietal pleura. All types of cells contained some of the oil.

Conclusions drawn from these observations were: (1) When bronchiectasis is present and the usual 20 c.c. of oil is injected into the trachea, it is quite possible for many of the dilatations to receive no oil. (2) In experimental animals atelectasis with a resulting pneumonitis occurs when normal lungs are injected. The possibility of this occurring in the patient is suggested. (3) Iodized oil remains much longer in the diseased lung than in the normal lung which is an advantage if prolonged contact is desired in the treatment of bronchiectasis.—*J. H. Harris.*

CHRISTOPHERSON, J. B. The anatomy of chronic bronchitis and bronchial asthma as disclosed by lipiodol examination. *Am. J. M. Sc.*, Oct., 1933, *186*, 504-509.

The author does not believe that bacterial invasion is the fundamental cause of chronic bronchitis. The roentgen ray and the bronchoscope have not been of aid in diagnosis of the local condition which is the most important consideration in treatment. The bronchial tree is not an organ of mechanical pipes but rather a system of living channels, whose musculature, contracting and expanding under the control of the autonomic nervous system, is constantly altering its caliber. Chronic bronchitis is due to physiological and pathological changes in these tubes and a knowledge of their exact anatomic condition in every case is essential for diagnosis and treatment.

Lipiodol injection for accurate determination of bronchial anatomy, as well as for therapeutic effect, is recommended. It is thought that chronic bronchitis is fundamentally due to dominant sympathetic influences, which cause, among other symptoms, relaxation of the musculature of the bronchial tree. In most cases of chronic bronchitis in which lipiodol has been injected, dilated beaded varicose bronchi were seen. These may be only a few isolated swellings or may be general throughout. The larger bronchi are always dilated.

Lipiodol does not enter the alveoli of the normal lung unless the patient coughs. The terminal bronchioles are guarded by a sphincter-like development of their musculature, the author believes. In emphysema there is a permanent relaxation of this sphincter and lipiodol always enters.—*J. H. Harris.*

SUNDBERG, C. G. The roentgen kymogram of the normal heart. *Acta radiol.*, Dec., 1933, *14*, 558–574.

The author has studied the conditions under which kymograms should be taken in order to

reproduce displacements of the heart outline accurately and describes a roentgen kymogram with an apparatus for recording the electrocardiogram simultaneously. In experiments on dogs the movements of the different parts of the heart, particularly the auriculo-ventricular boundary, were examined and recorded and the basal kymograms are reproduced. Changes in the size of the orifices were studied by stereometrical calculations on roentgenograms of animal hearts prepared in situ for this purpose.

The roentgen kymogram of the human heart is analyzed by comparison with an electrocardiogram registered synchronously and the interpretation of the kymograms of the aorta, ventricle and auricle are discussed.—*Audrey G. Morgan.*

Dyson, John M. The radiologic recognition of heart disease in pneumoconiosis. *Am. J. M. Sc.*, Aug., 1933, *185*, 165–170.

Attention is called to the normal cardiac silhouette and to the fact that right ventricular hypertrophy is manifested by a bulging of the left border of the heart shadow between the shadow of the knob of the aorta and that of the left ventricle. Right pulmonary conus hypertrophy and visibility of the pulmonary artery are usually caused by mitral disease, chronic pulmonary fibrosis and any other condition which causes prolonged pulmonary stasis.

As fibrosis is the result of pneumoconiosis, hypertrophy of the right ventricle occurs and the changes described in the cardiac outline result. Abstracts of 5 cases illustrating this condition are given.—*J. H. Harris.*

ABDOMEN

Åkerlund, Å. Die anatomische Grundlage des Röntgenbildes der sogenannten "erworbenen Hiatusbruche." (The anatomical foundation of the roentgenogram of the so-called "acquired hiatus hernias.") *Acta radiol.*, 1933, *14*, 523–544.

There has been an active discussion in recent years as to whether there is really an acquired hernia of the esophageal hiatus. The author has divided these cases into three groups: (1) cases with a congenitally short esophagus in which the esophagus has not descended normally into the abdomen; (2) cases of paraesophageal hernia in which the esophagus has descended and does not really lie in the hernia but beside it; (3) cases in which the esophagus has descended normally but has risen through the hernia. These are the cases he considers acquired and this view has now been adopted by many roentgenologists. The first two groups are congenital.

In roentgen examination the hernia may be filled from below through the stomach. This is the coarser and simpler method but is sufficiently accurate for the diagnosis of the more advanced cases. Filling from above directly through the esophagus is better adapted for the diagnosis of beginning cases. There is considerable doubt, however, as to the clinical importance of these beginning cases.

The normal anatomy of the hiatus is discussed as well as the mechanism of origin and later development of acquired hiatus hernia based on anatomical investigations. A beginning protrusion upward through the hiatus is brought about by various causes such as stretching of the hiatus, insufficiency of its musculature, reduction of the fatty tissue in the hiatus, decreased elasticity of the elastic tissue of the hiatus, loosening of the periesophageal or intraperitoneal connective tissue or increase of positive intra-abdominal and negative intrathoracic pressure from different causes such as prolonged attacks of coughing, meteorism, chronic constipation, abdominal tumors, ascites, repeated pregnancies, chronic emphysema of the lungs, chronic bronchitis or asthma. The abdominal part of the esophagus passes through the hiatus first and then the adjacent parts of the stomach follow. The protrusion at first is a hernia without a sac and bulging of the peritoneum does not begin until it has reached a considerable size. The fact that there is no peritoneal covering at first the author maintains is no reason for not calling the protrusion a hiatus hernia. It may, if preferred, be called a small sacless hiatus hernia.

Roentgen examinations and special anatomical examinations in old individuals have shown that small sacless visceral protrusions through the esophageal hiatus which are the beginning stages of acquired hiatus hernia are so common that they may be called physiological changes of age. Pronounced cases of acquired hiatus hernia with a hernial sac are of course much rarer but they are considerably more common than has been generally believed.

The author describes 8 cases which he thinks refute the opinion of Sauerbruch, Chaoul and Adam that there is no such thing as acquired reducible hiatus hernia. In all of the 8 cases anatomical examinations showed a real hiatus hernia with a sac.—*Audrey G. Morgan.*

BIGNAMI, GIUSEPPE. Sull'ernia diaframmatica congenita. (Congenital diaphragmatic hernia.) *Radiol. med.*, Nov., 1933, *20*, 1351–1361.

A case is described in a child ten days old whose parents brought him for examination on account of increasing dyspnea which had existed since birth. At intervals he had attacks of suffocation and became very cyanotic. Roentgen examination showed a left diaphragmatic hernia with the abdominal viscera pushed into the left half of the thorax and the heart displaced to the right with very serious compression of the lung tissue. There was no lung outline on the left but only the gas-filled intestine, almost the whole of which had been forced into the left half of the thorax. It was impossible to do anything for the child and he died in a few days.

The author then discusses the pathogenesis of hernia and its classification into true and false, acquired and congenital, fetal and embryonic. He gives roentgenograms illustrating the difference between hernia and eventration in adults, and emphasizes the difficulty of making this differentiation in infants, and also stresses the great importance of roentgen examination in diagnosing congenital diaphragmatic hernia in infants. A roentgen examination should be made if there is the slightest clinical suspicion of such a condition.—*Audrey G. Morgan.*

GIORDANO, MICHELE. Un caso di perforazione acute nel tenue di cisti da echinococco addominale. Contributo radiologico. (Roentgen diagnosis of an abdominal echinococcus cyst perforated into the small intestine.) *Arch. di radiol.*, 1932, *8*, 457–463.

The patient, a healthy man of sixty, was suddenly seized with intense pain over the whole abdomen; he had an intense desire to defecate and evacuated a large quantity of blood. Soon afterward there was copious bilious vomiting; he had a high temperature and his pulse was almost imperceptible. The abdomen was greatly distended, painful and rigid. A physician who was called in made a diagnosis of perforative peritonitis and advised immediate operation which was refused. The patient's condition improved and after a few days it was possible to make a roentgen examination which showed a large round opaque area with smooth lower walls in the pelvis; the upper boundary was irregular and had an air space above it. On further observation the opaque liquid from this mass was seen to empty into a loop of the small intestine. A diagnosis of echinococcus cyst perforated into an adherent loop of small intestine was made and proved on operation to be correct. There was not a trace of peritonitis. The severe symptoms in the beginning had not been caused by peritonitis but by internal hemorrhage and anaphylaxis from absorption of the large amount of liquid suddenly poured into the small intestine through the perforation.—*Audrey G. Morgan.*

LENARDUZZI, GUERRINO. Diverticolo congenito dello stomaco, diverticolo funzionale del colon, pseudo-diverticolo della colecisti per inginocchiamento congenito del fondo nello stesso sogetto. (Congenital diverticulum of the stomach, functional diverticulum of the colon and pseudo-diverticulum of the gallbladder from congenital kink of its fundus in the same individual.) *Arch. di radiol.*, 1932, *8*, 444–456.

A case is described in a girl of sixteen who came for examination because of symptoms of colitis. Roentgen examination showed a congenital diverticulum of the cardiac part of the stomach and a spastic condition of the colon with a diverticulum of the colon that was shown to be functional by the fact that it was transitory. The contractility of the gallbladder was tested with Bronner's egg-yolk medium and a congenital pseudo-diverticulum was found due to a kink of the fundus resulting in a spur projecting into the cavity which gave the appearance of a true diverticulum. The spur in such cases is formed by adhesion of the two parts of the wall that are brought into contact with each other by the kink, without inflammation. These pseudo-diverticula of the gallbladder are generally associated with other congenital anomalies, as they were in this case. To demonstrate them requires not only a simple cholecystography but also a study of the emptying of the gallbladder.—*Audrey G. Morgan.*

BUISSON, MARIO. La diagnosi delle ulceri duodenale multiple. (Diagnosis of multiple duodenal ulcers.) *Radiol. med.*, Nov., 1933, *20*, 1370–1376.

The author describes 3 cases of double duodenal ulcers and one triple duodenal ulcer diagnosed by the method of "dosed" compression. They are illustrated by roentgenograms. He

says that the diagnosis cannot be based on indirect local signs such as incisures, which may be deceptive, but can only be based on direct demonstration of multiple niches which are the only pathognomonic signs. He discusses the appearance of some bulbs with a rigid canal and several pseudo-diverticular chambers and concludes that they are not manifestations of multiple ulcers but of a single central parietal ulcer.—*Audrey G. Morgan.*

Clark, Daniel M., and Geyman, Milton J. Roentgen evidence of healing in duodenal ulcer. *J. Am. M. Ass.*, 1934, *102*, 107–112.

The usual examination of the duodenum is not very convincing in the diagnosis of activity or degree of healing of duodenal ulcer. The presence of a niche is definite evidence of an active ulcer but its disappearance is not proof of healing but rather of a favorable response to treatment. The base may be merely filled with granulation tissue, this occurring a few days after institution of treatment but the ulcer cannot be considered healed until the defect is epithelialized.

In all cases an effort should be made to visualize the niche. The compression method of Berg et al is more efficient than older methods. Deformity of the outline of the bulb means that an ulcer has been or is present but is valueless in determining the degree of healing.

Duodenal ulcers heal more slowly than gastric ulcers The time of disappearance of the niche varies from nine or ten days to several months. The patient may become symptom-free while the niche persists.—*E. W. Hall.*

de Vel, Leon. Intestinal perforation with pneumoperitoneum in the new-born infant. *Am. J. Dis. Child.*, March, 1933, *45*, 587–589.

Two cases of intestinal perforation in the new-born infant are reported in which the presence of gas in the peritoneal cavity was demonstrated by roentgenograms. In one case, a large amount of gas was shown in the abdomen and in the second the gas could be seen between the liver and the abdominal wall and the diaphragm. De Vel emphasizes the usefulness of the roentgen examination in making the correct diagnosis.

Boikan has divided the cases of intestinal perforation of the new-born infant into two large groups. The first embraces all cases that are associated with an obstruction of the bowel and in which perforation occurs proximal to the obstruction. In the second group, the perforation is not associated with obstruction.

Etiologically, the condition in the cases not associated with obstruction is variously attributed to trauma, to meconium stasis, to intestinal aplasia with faulty or deficient innervation, to primary vascular insufficiency and to congenital or acquired diverticula. In the first case here reported, the perforation occurred independent of any macroscopic malformation, such as strictures, bands or diverticula. The microscopic section showed, besides the total necrosis of all layers of the intestinal wall at the site of perforation, a distinct thinning of the muscular layers as the section progressed toward the lesion. Furthermore, some fairly large blood vessels situated in the vicinity of the perforation appeared to be thrombosed, suggesting the possibility of mesenteric thrombosis.—*R. S. Bromer.*

Colombo, Ettore. Un caso di tubercolosi del tenue. (A case of tuberculosis of the small intestine.) *Arch. di radiol.*, 1932, *8*, 766–772.

A man of thirty-nine came for treatment complaining of general weakness and anemia. For the past three months he had had epigastric pain about four hours after meals. For years he had had a feeling of weight beneath the left costal arch. Palpation showed pain in the epigastrium and left hypochondrium and a resistance not movable on the underlying tissues. There was no fever, the leucocyte formula was normal and the gastric juice normal. There was blood and *Ankylostoma* ova in the feces. This was assumed to be the cause of the weakness and anemia and the patient was treated for that complaint and discharged. He returned about a month later because the pain had increased. Roentgen examination showed the picture which Freud has described as characteristic of sarcoma at the level of Treitz' ligament. Operation showed a tuberculous mass at the root of the mesentery and irregular infiltration of the walls of a loop of jejunum with a number of tubercles on the serosa. The patient died two and a half months later.

It is unusual to find a solitary focus of tuberculosis so high up in the small intestine and the similarity to the picture of sarcoma is worthy of note.—*Audrey G. Morgan.*

Vita, G. L'esplorazione radiologica della mobilita colica. (Roentgen investigation of the

mobility of the colon.) *Arch. di radiol.*, 1932, *8*, 537–554.

The author describes a method which he himself has developed, by means of which it is possible to determine whether any given segment of the colon is fixed by adhesions or not. It consists in observing the changes in form that take place in the intestine after the administration of a drastic purgative. If after the usual study of the digestive tract any part of the colon remains fixed in a vicious position in spite of all the technical artifices generally used and adhesions are suspected, a drastic purgative (castor oil) is given in the morning and in the evening the patient is given a barium suspension. The next morning roentgenograms are taken in the same position and with the same projections as those taken before the administration of the purgative. If the intestine is free of adhesions it will have changed its form and assumed an entirely different position; if it has not changed it means that there are fixed adhesions that have prevented its doing so.

The author describes 2 cases in which no mobilization took place after this test; operation showed that the intestine was fixed by adhesions. In 2 other cases, on the other hand, in which adhesions had seemed certain after the ordinary methods of examination, such changes had taken place after the purgative that it was certain that the flexure was not fixed by adhesions.

The article is illustrated by roentgenograms.—*Audrey G. Morgan.*

MASHERPA, FERMO. Sulla diagnosi radiologica di calcolo appendicolare. (Roentgen diagnosis of calculi of the appendix.) *Arch. di radiol.*, 1932, *8*, 385–406.

True calculi of the appendix are comparatively rare. Most of the cases published so far have been found on operation without an accurate diagnosis having been made beforehand.

A case is described in a man of thirty-two who had suffered from digestive disturbances with nausea and vomiting at times and attacks of pain which radiated to the testicle and the thigh. He had been examined by several physicians, some of whom made a diagnosis of chronic appendicitis and some of kidney stone. A preliminary roentgen examination showed a round, intensely opaque shadow in the right lower quadrant of the abdomen. An opaque meal was then given and the examination showed an appendix slender at the base and ending in a club-shape with a deep shadow at the end. The appendix and the opaque shadow always moved together. An examination in the lateral projection made to dissociate the shadows showed the shadow of the calculus always a continuation of the appendix. Pressure over the calculus was moderately painful. Reexamination a month later showed the same findings.

Calculi of the appendix are generally larger than the normal lumen of the organ, as the calculus increases in size concentrically. As a result, the wall of the appendix is stretched until it is very thin and there is always danger of rupture. Hence the importance of roentgen examination and operation in these cases. These stones are generally solitary, though as many as four have been found. They are most frequently confused with calculi of the vessels or ligaments, enteroliths, bile calculi or stones of the ureter. Differential diagnosis may be made by filling the appendix with contrast and noting whether the stones move with it. Calculi of the ureter can generally be diagnosed by means of an opaque sound introduced into the ureter, though this test may fail. A case is cited in which two shadows near that of an opaque sound introduced into the right ureter moved with the sound and as the injection of contrast fluid showed a dilatation of the ureter a diagnosis of stone of the ureter was made. Operation, however, showed two stones in the appendix which was adherent to the ureter. However, by the use of suitable projections and by careful observation of the movements of the stone on palpation a differentiation can generally be made.—*Audrey G. Morgan.*

GUARINI, CARLO. Modificazioni osservate dopo epato-lienografia in leucemici. Nota preventiva. (Changes seen after hepatosplenography in leucemia. Preliminary note.) *Arch. di radiol.* 1932, *8*, 462–463.

Thorotrast has been used as a medium for the roentgen demonstration of the liver and spleen and the author used it in patients with leucemia in order to study the changes made in the spleen by roentgen irradiation. He gave injections of thorotrast in several cases of leucemia and found that in the interval of ten days between the first and second injections the spleen had decreased considerably in size without any roentgen irradiation being given.

Further confirmation of this beneficial action of thorotrast in leucemia is necessary. The author gives this brief preliminary note in order to call the attention of roentgenologists to the radioactivity of thorotrast and its possible beneficial and harmful effects.—*Audrey G. Morgan.*

McClendon, S. J. Gallstones in children; a case diagnosed by roentgen examination. *Am. J. Dis. Child.*, March, 1933, *45*, 584–586.

McClendon reports a case of gallstones occurring in a girl aged eleven, in whom the cholecystograms showed a dilated gallbladder containing stones. At operation the gallbladder was found to be greatly dilated, and the stones were palpated. Three stones were removed from the common duct and cholecystectomy was performed. Eighteen small stones were found in the gallbladder. The patient made an uneventful recovery.

The author states that the symptoms of cholecystitis and cholelithiasis in children resemble the symptoms of appendicitis, and are often accompanied by the latter. Jaundice usually appears either before or during an attack. There is pain in the right quadrant of the abdomen or near the umbilicus and vomiting is present. The gallbladder may be palpated, and the liver may be larger than normal. Tenderness is elicited over the area of the liver and gallbladder, and there may be rigidity of the right rectus muscle. The blood count shows moderate increase in the number of leucocytes and the urinalysis shows the presence of bile. The icterus index is increased.

Reports of autopsies performed on infants have shown the presence of stones as such and also the presence of softer concretions which undoubtedly form the later stones of childhood. Such stones are probably congenital in origin. Stones may also form following a typhoid infection or may be the result of an inflammation of the gallbladder caused by a narrowing of the cystic duct.

The presence or absence of gallstones can be demonstrated by roentgen examination prior to surgical exploration. In cases of gallstones alone with no obstruction of the common duct, cholecystography offers the most accurate means of arriving at a diagnosis.—*R. S. Bromer.*

Dall'Acqua, Virgilio. Miglioramenti della tecnica colecisto grafica per via orale col metodo delle dosi refratte. (Improvement in the technique of oral cholecystography by means of fractional doses.) *Arch. di radiol.*, 1932, *8*, 64–80.

Heretofore the oral method of cholecystography has not been found as reliable as the intravenous method, but by the method introduced by Sandström this difficulty has been overcome. There are three modifications of Sandström's technique: In the first the patient is given half a dose of the contrast medium (iodotetragnost) dissolved in alkaline mineral water on going to bed the first day. The full dose is 3 to 4 grams depending on the weight of the patient. On the second day the patient is forbidden eggs, fats, milk and carbohydrates which might cause gas; he is also advised to take a lighter diet than usual. The last meal is taken not later than 5 o'clock. At 9 he is given a full dose of contrast medium. On the third day the examination is begun in the morning at 9 o'clock after a cleansing enema and with the stomach completely empty. In the second modification a half dose of the contrast medium is given on the evening of the first day; on the second day a full dose is given in two parts, one in the morning and the other in the evening at 9 o'clock. The examination is made on the third day. In the third modification the last meal on the first day is taken not later than 5 o'clock and should be very light. A full dose of the contrast medium is given at 9 o'clock. The examination is begun the next morning with the stomach empty.

The author used Sandström's technique with some slight changes in 50 cases and found that the results agreed in all cases with those of the intravenous method. He concludes therefore that Sandström's method of oral cholecystography with divided doses is the method of choice and that the intravenous method should only be used in exceptional cases in which there is too rapid elimination by the oral method. Such rapid elimination can be prevented, however, by giving a sedative such as laudanum or opium.

In the combined examination of the gallbladder and digestive tract a dense and well-homogenized aqueous suspension of barium should be used, such as gelobarin or idrobarin for the examination of the stomach and duodenum. This shows the mucous membrane relief of these organs without causing emptying of the gallbladder. After filling the right colon it is possible to study its relations to the gallblad-

der. After this the function of the gallbladder may be studied by means of Bronner's test.—*Audrey G. Morgan.*

MILANI, EUGENIO. I dati colecistografici della vescicola a fragola nel vaglio del controllo operatorio. (Cholecystographic data in regard to strawberry gallbladder as shown by operative control.) *Radiol. med.*, Nov., 1933, *20*, 1384–1403.

The author discusses the cholecystographic data in regard to strawberry gallbladder based on 79 cases of cholecystectomy. Among these 79 cases there were 18 of strawberry gallbladder. In strawberry gallbladder the external appearance is not infrequently normal; the inner surface is shagreened or granulated, the granulations being yellowish white. This is caused by a condition of lipoidosis. Frequently these gallbladders appear normal by the Graham intravenous or oral method of cholecystography. With Bronner's test, which is an egg-yolk test for motility of the gallbladder, they may contract quite rapidly. They may be diagnosed however by means of Antonucci's rapid method of cholecystography which consists in the injection of a glucose solution of tetraiodide (125 c.c. of a 40 per cent solution of glucose). The glucose causes a more rapid afflux of bile charged with iodine and the gallbladder becomes visible within an hour, with the maximum visibility at the end of two hours.

Cases of strawberry gallbladder are described which color normally by the Graham method but did not show any coloring by this rapid method at the end of two hours. It is a method of detecting abnormal gallbladders that are not shown by the Graham method. The clinical symptoms in these cases are generally digestive rather than typical gallbladder symptoms.—*Audrey G. Morgan.*

ANZILOTTI, ALBERTO. Contributo all'interpretazione della colecistografia negativa. (Interpretation of negative cholecystograms.) *Arch. di radiol.*, 1932, *8*, 26–63.

The author examines the various causes of negative results in cholecystography and discusses their significance in diagnosis. If errors of technique can be excluded, there are three causes of failure of the gallbladder to show in the cholecystogram: (*a*) a change in function of the excretory cells of the liver; (*b*) negative or insufficient flow of opaque bile into the gallbladder, and (*c*) a change in the capacity of the gallbladder for concentrating the bile.

Negative results have frequently been observed in diseases lying outside the bile tract, such as ulcers of the pylorus and duodenum, pancreatitis, appendicitis, cancer and some general diseases such as diabetes, Basedow's disease and infections. These negative results are due to various causes. The negative results in pancreatitis may be due to changes in the tonus of Oddi's sphincter. It may also be due to an extension of the infection to the bile ducts. In some cases mechanical or functional stagnation of bile may be the cause of at least temporary negative results as the opaque bile flowing into the gallbladder is diluted to such a degree that it does not produce a shadow. Some authors believe that negative results in Basedow's disease are due to an irritated condition of the vegetative nervous system which causes a hypermotility of the gallbladder and consequently interferes with good concentration of the bile.

The author believes that many negative results are due to injury of the chromagogue function of the liver, that is, the capacity for elective secretion of tetraiodophenolphthalein on the part of the liver cells. This does not mean serious injury of the liver parenchyma with total or almost total abolition of the function of the gland, but a simple dysfunction of the cells, as a result of which the contrast medium is excreted into the gallbladder so slowly that it does not produce a roentgen image. The liver may be affected in this way by tuberculosis, syphilis and various chronic intoxications such as alcoholism and lead poisoning. A number of cases are described in which the cholecystograms were negative without demonstrable disease of the bile tract but functional liver tests showed insufficiency.

The chief causes which interfere with a flow of bile into the gallbladder and in this way cause negative cholecystograms are catarrhal icterus, severe sclerotic cholecystitis or pericholecystitis, pressure on the gallbladder or cystic duct, carcinoma of the biliary tract, calculi of the gallbladder and impermeability of the cystic duct. In non-calculous cholecystitis negative results may be due to defective concentrating capacity of the gallbladder.

The author then discusses 62 cases of negative cholecystograms controlled by operation. In 13 of these cases the disease was outside the bile tract; in the other 49 there was disease of the bile tract, chiefly cholecystitis. He believes

that in the majority of cases negative cholecystograms are due to disease of the biliary tract and that in the cases in which other organs are involved the correct diagnosis can be arrived at by clinical examination and liver function tests. —*Audrey G. Morgan.*

YATER, WALLACE M., and OTELL, LAURENCE S. The differential diagnosis of diseases of the liver and spleen with the aid of roentgenography after the intravenous injection of thorium dioxide sol (thorotrast); experience with eighty patients. *Ann. Int. Med.*, Sept., 1933, *7*, 381–395.

A comprehensive discussion of the intravenous administration of thorium dioxide sol for visualization of the liver and spleen is presented by the authors, who record their observations on 80 patients studied by the method. The radiopaque thorium dioxide is taken up by the reticulo-endothelial system without apparently impairing any of the probable functions of these cells. The alpha-ray activity of the solution has been considered sufficient to be a potential danger when dispersed through the tissues, but the authors state that proofs of such effects are totally lacking. Reactions following the injection were few and mild. The method may determine: (1) the presence of enlargement of the liver or spleen, (2) whether a mass in the upper abdomen is liver, spleen or other structure, (3) metastases in the liver, (4) the presence of a primary tumor, cyst or abscess in the liver, (5) in many cases, the nature and extent of intrahepatic diseases such as cirrhosis and extensive scarring from syphilis, (6) the progress of such diseases, (7) the presence of free fluid in the abdomen, (8) the existence of tumor, infarct, abscess, fibrosis or leucemia of the spleen, (9) rupture of liver or spleen, (10) position of the diaphragm, (11) the presence of accessory spleens, and (12) possibly the presence of common bile duct obstruction. In the authors' series, the method was diagnostic in 24 cases, suggestive in 11, confirmed the presence of an enlarged liver or spleen or both in 13, was of value in ruling out hepatic or splenic lesions in 12, and determined the nature of an undiagnosed abdominal mass in 7 cases. No help was obtained from its use in 8 cases and a wrong diagnosis resulted in 1 case. It is considered a laboratory procedure, not replacing clinical methods of diagnosis, but offering considerable help as an adjunct procedure.—*W. R. Brooksher.*

GENITOURINARY SYSTEM

SANTORO, M. Ectopia cecale. Sindromi gastroduodenali cliniche e radiologiche da appendiciti sotto-epatiche. (Displacement of the cecum. Clinical and roentgenological gastroduodenal syndromes from subhepatic appendicitis.) *Arch. di radiol.*, 1932, *8*, 355–371.

Two cases of anomaly in position of the cecum and appendix are described. The clinical symptoms in both cases were those of ulcer. In the first case in a young woman of twenty-one the roentgen examination showed a niche in the upper border of the antrum of the pylorus which was not modified by pressure, which was very painful. The last loop of the small intestine was directed upward toward the crest of the ilium where it passed into an opaque mass which proved to be the cecum with its base directed upward at the level of the right crest of the ilium and passing still further upward and to the right was a cord-shaped shadow which represented the inflamed appendix. It was abnormally long. The author did not attribute great importance to the niche in the antrum as he believed it was caused by perigastritis. Even hemorrhage, which this patient had had, may be caused by perigastritis. Operation confirmed his diagnosis. The appendix was removed and the cecum fixed in position and the patient was seen five months after the operation completely well.

In the second patient, a man of twenty-three, roentgen examination showed the stomach enlarged and elongated; pylorus permeable with rapid emptying at first and then spasm. The bulb of the duodenum was deformed; there was spasm of the base of the bulb and a niche of the lesser curvature which appeared irregular and dentate. The bulb was painful on pressure. The ileocolic loop was directed upward and emptied into an opaque mass three fingers breadths above the crest of the ilium. This mass was made up of the cecum, the base of which was turned upward, and of the ascending colon which was directed downward so that the hepatocolic angle lay in the iliac fossa. A cord-shaped shadow passed out from the cecum which remained filled for fifty hours after the paste was taken. The colon was abnormally long. In this case a diagnosis was made of ulcer of the duodenum and displaced cecum. Operation did not show any abnormality of the duodenum. The appendix was removed and adhesions between the duodenum and gall-

bladder broken, and the cecum replaced. The patient recovered and four months after the operation was free of symptoms and did not show any abnormality of the stomach or duodenum.

The author emphasizes the importance of complete roentgen examination of the whole digestive tract in cases suspected of ulcer.—*Audrey G. Morgan.*

CAMPBELL, MEREDITH F. Renal tuberculosis in juveniles. *Am. J. Dis. Child.*, March, 1933, *45*, 555–571.

Campbell prefaces his paper by the statement that although renal tuberculosis is not common in children except as part of a generalized infection, the incidence of the lesion as manifested by so-called chronic pyelitis is sufficiently high to merit serious consideration. He reports 4 personal cases of surgical renal tuberculosis in children (three, seven, eight and eleven years, respectively) who were treated by nephrectomy and a bilateral nonsurgical case (seven years of age), together with 1 case of calcified renal tuberculosis in a boy aged seventeen. All of the patients were examined because of persistent pyuria; in 2 cases, urinary frequency with incontinence had led to the diagnosis of enuresis. Early recognition of unilateral renal tuberculosis with prompt nephrectomy may usually be expected to result in cure; with delay, bilateral involvement and a fatal outcome may be expected. In Campbell's experience renal tuberculosis has been the underlying lesion in about 1 of every 65 cases of "chronic pyelitis."

Renal tuberculosis is always secondary to tuberculosis elsewhere. In children, the initial focus is most often in the lungs, lymph nodes or intestinal tract. Coexistent skeletal lesions are often secondary to the same focus as the renal disease. Current opinion holds that the renal invasion is hematogenous in most instances. In the development of the tuberculous process, a mixed infection frequently exists. Colon bacilli are most often found; these seem to withstand the bacteriostatic effects of tuberculotoxin better than other organisms. On the other hand, the culture may be sterile. Parenthetically, a sterile pyuria is most likely to be tuberculous.

Surgical renal tuberculosis is most often of the caseocavernous variety, but may be pyonephrotic, nodular or sclerotic. In speaking of chronic renal tuberculosis, the caseocavernous type is usually meant; pyonephrosis is but an advanced form of the caseocavernous lesion. The nodular and sclerotic varieties are evidence of an unusual local resistance to the infection. The kidney of chronic tuberculosis is surrounded by fibrolipomatosis. The ureter becomes thickened, scarred, strictured and surrounded by contracting fatty scar. These obstructing lesions lead to hydronephrosis and pyonephrosis, often with pelvic stone formation. In some instances autonephrectomy (sealing off of the ureter with excommunication of the tuberculous kidney) occurs. Ureteral contracture leads to trigonal distortion; sometimes the orifice appears high in the posterior wall of the bladder.

Nephritic changes in the good kidney and in the uninvolved portion of the tuberculous one are due to tuberculotoxin and are manifested by albuminuria, casts and, sometimes, red blood cells, but they usually disappear with removal of the diseased kidney. The changes in the bladder are those of congestion, edema, ulceration, necrosis and sclerosis, dependent on the intensity and duration of the disease and the repair process. Ulceration may be replaced by granulation tissue. These changes are of great importance in the cystoscopic diagnosis of renal tuberculosis, and while their visualization is not absolutely pathognonomic, they are characteristic. In early renal tuberculosis, the cystoscopic picture is often normal.

In the initial clinical stages of the disease, only one kidney is involved. Involvement of the second kidney may be hematogenous or, perhaps more frequently, ascending (urogenous) through the uretero-vesical orifice, which is diseased and rendered incompetent by vesical tuberculosis. This phenomenon indicates the urgency of early recognition of renal tuberculosis and treatment by nephrectomy. No case of spontaneous cure, Campbell says, has ever been reported; most apparent cures result from autonephrectomy.

In three-fourths of the patients with chronic renal tuberculosis, disturbance of urination—frequency, dysuria, burning, tenesmus and so forth—is the initial and outstanding symptom. Pyuria always exists, is usually macroscopic, but may be microscopic and commonly causes a diagnosis of chronic pyelitis to be made. Often pain is absent. Painless hematuria may herald the disease. The passage of blood clots or débris may produce colic. Secondary involvement of the psoas muscle may cause disease of the hip

joint or spinal tuberculosis may be diagnosed. Systemic symptoms are those of tuberculotoxemia or, with advanced bilateral renal disease, uremia. Fever is usually continuous, and low grade, but may be hectic or intermittent dependent on the activity of the infection and on the adequacy of urinary drainage. Gastrointestinal upsets—anorexia, indigestion, "biliousness," "gastritis," nausea or vomiting—may occur in half the cases. When the second kidney is markedly affected by tuberculosis or by tuberculotoxic nephritis, anemia develops, but the debilitated child usually dies of an intercurrent infection, notably pneumonia. Fatal acute miliary disease may occur.

A preliminary roentgenogram of the urinary tract may show calcified tuberculous lesions, stones, the renal outlines and congenital or inflammatory bone lesions. Campbell employs catheterization of the ureter, with the collection of specimens, and a dye function test (indigo carmine). He has never seen an ill effect from pyelography in children. When the ureter is impassible, intravenous pyelography must be used. The urogram of chronic renal tuberculosis may be characterized by a motheaten pelvic outline, calyceal distortion or contracture, pelvic irregularity, ureteral stricture or, in some cases, hydronephrosis or complete pelvic blockage. Early lesions are often confined to one calyx; the remainder of the tract is normal. Localized pyelographic shadows in the parenchyma beyond the calyces are pathognomonic of tuberculous necrosis.

Treatment by nephrectomy should be performed at once if the disease is unilateral. When tubercle bacilluria exists without pelvic changes, operation should be withheld until such time as the diagnosis is not questionable. Especially in children, nephrectomy in the presence of evident bilateral tuberculosis is contraindicated. Tubercle bacilli in both specimens from the ureter do not necessarily mean bilateral renal tuberculosis; in such cases the organisms may have entered the catheter by ureteral reflux from the infected bladder. In some instances, treatment in a sanatorium before operation should be of value, and its equivalent for a few months after operation should be insisted upon. Tuberculin therapy merits no great reliance in these cases. With early radical treatment and proper postoperative care, especially of the sanatorium variety, complete cure may be expected in fully half the cases.—*R. S. Bromer.*

Swick, Moses. Excretion urography; with particular reference to a newly developed compound: sodium ortho-iodohippurate. *J. Am. M. Ass.*, Dec. 9, 1933, *101*, 1853–1857.

Sodium ortho-iodohippurate is recommended for excretion urography because it utilizes as a radical for the attachment of an opaque element a derivative of a substance found normally in human urine and is therefore nontoxic and well tolerated. It is highly soluble, neutral in solution and yields satisfactory urograms with relatively small doses, a concentration of 50 per cent being used. No iodism or local necrosis has been observed and the only reactions noted are occasional transient nausea, vomiting and feeling of warmth. Ten to 15 grams are used, injection consuming five minutes and exposures being made ten minutes thereafter and two more at twenty-minute intervals.

Good urograms are also obtained in about 50 per cent of cases by films made from 90 to 135 minutes following oral administration of 15 grams of the salt in syrup.

General considerations as to the use of excretion and retrograde urography are discussed.—*E. W. Hall.*

Kretschmer, Herman L., Heaney, N. S., and Ockuly, E. A. Dilatation of the kidney pelvis and ureter during pregnancy and the puerperium; a pyelographic study in normal women. *J. Am. M. Ass.*, Dec. 23, 1933, *101*, 2025–2029.

Previous retrograde pyelographic studies having shown a high percentage of ureteropelvic dilatation in pregnant women, the authors studied 54 cases by the intravenous method, thus eliminating the possible factor of distention by injection. Dilated pelves and ureters were observed in 100 per cent of the cases during pregnancy or the puerperium, though none of the 54 cases developed pyelitis during pregnancy. With one exception, dilatation increased with progression of the pregnancy. Dilatation of the ureter is almost always above the pelvic brim but no causal relation between position and presentation of the fetus and dilatation or ureteral displacement could be discovered.—*E. W. Hall.*

Lee, Harry P., and Mengert, William F. The effect of pregnancy on the urinary tract. *J. Am. M. Ass.*, Jan. 13, 1934, *102*, 102–107.

The reports of numerous investigations are in accord that the ureters and kidney pelves

are dilated in nearly all pregnant women. Arguments have been advanced to prove the dilatation due to obstruction. Studies both by excretion urography as well as by retrograde pyelography and inlying catheters have led the authors to believe the cause is not obstruction but some obscure condition peculiar to the pregnant state. In no case was passage of a ureteral catheter difficult, inlying catheters did not reduce the size of the dilated organs, and stereoscopic ureterograms showed smooth ureteral curves unrelated to the pelvic brim, rather than sharp kinks or strictures. Return to normal was rapid after delivery.—*E. W. Hall.*

GIORDANO, MICHELE. A proposito d'un caso di grossa idronefrosi clinicamente muta, svelata dalla pielografia endovenosa. (A case of large hydronephrosis clinically latent revealed by intravenous pyelography.) *Arch. di radiol.*, 1932, *8*, 532–536.

A patient twenty years of age with a hypospadias of the third degree came for treatment with a typical history of intermittent renal colic on the right side. He had never had the slightest symptom on the left side, not even a sense of weight. A physician a month before had taken a roentgenogram which showed a kidney stone on the right side. Before surgical operation an attempt was made to catheterize the ureters to determine kidney function but the smallest cystoscope would not pass. Intravenous pyelography showed a large hydronephrosis on the left side; there was great dilatation of the pelvis and all the calyces and a very small ureter. This malformation was doubtless congenital.

The case shows the value of intravenous pyelography, or excretory urography as it is now called, in examinations of the urinary tract. In this case not only did it show the unsuspected hydronephrosis but it demonstrated that kidney function on the hydronephrotic side was good, as the small ureter was very opaque, showing good elimination of the contrast medium on the part of the hydronephrotic kidney.—*Audrey G. Morgan.*

BUISSON, MARIO. Le sindromi dolorosi lombo-ischialgiche e le alterazioni dell'apparato urinario. (Pain of the lumbosciatic type and changes in the urinary system.) *Arch. di radiol.*, 1932, *8* 407–425.

The author's investigations confirm the work of Mainoldi, Ottonello and Nuvoli in regard to the relationship existing between malformations of the lumbosacral spinal column and disease of the urinary tract. Among 96 patients with disease of the urinary tract examined by retrograde pyelography 59, or 61 per cent, showed anomalies of the lumbosacral spinal column, such as lumbarization of the 12th dorsal vertebra, dorsalization of the 1st lumbar, sacralization of the 5th lumbar, rachischisis or anomalies in the number of the vertebrae. A number of the pyelograms are reproduced.

In cases of lumbar and sacral pain, therefore, associated with kidney symptoms, in which roentgen examination shows no stone, it would be a great mistake to assume that the kidney symptoms are reflex pain from the vertebral anomalies and that there is no disease of the urinary tract. Apparently in these anomalies of the spinal column there are also changes in the nervous system which bring about attacks of acute spasm of the urinary tract with chronic stagnation. The functional disease of the urinary tract may become organic in time and stones may eventually be formed by the deposition of salts in the stagnated urine. Therefore an understanding of this relationship between anomalies of the spinal column and urinary disease is highly important.—*Audrey G. Morgan.*

HYAMS, JOSEPH A., KENYON, H. R., and KRAMER, S. E. Urethrocystography in the male. *J. Am. M. Ass.*, Dec. 23, 1933, *101*, 2030–2035.

Urethrocystography in the male has the same applicability to lower urinary tract conditions as ureteropyelography has to those of the upper tract and is valuable in observing stricture, prostatic enlargement and bladder neoplasms and inflammations. Aqueous solutions are preferable to oily solutions both because of their greater penetrability into small glands and pockets and because in cases of urethrovascular injection, which is an ever present possibility, aqueous solutions do less harm. Gentle manipulations are essential and manometric pressure control is recommended.

Urethrocystography should be a routine procedure in all lower urinary tract conditions both for diagnosis and for recording the progress of cases.—*E. W. Hall.*

GOUVERNEUR and PORCHER. Un accident de pyélographie. (An accident of pyelography.) *Bull. et mém. Soc. de radiol. méd. de France*, Nov., 1933, *21*, 722–725.

The authors describe an accident which was observed during pyelography with collargol in a case of cancer of the kidney. Twenty-one cubic centimeters of the substance was injected by the routine method without any complaint on the part of the patient. Six minutes later the patient was suddenly taken with convulsions, the pupils became very large, the pulse filiform and then the patient lost consciousness. The collapse lasted for several minutes; following injections of ether, camphorated oil and adrenalin, the consciousness was regained, and after a while all symptoms of reaction disappeared. What happened is that the patient had a very vascular carcinoma of the kidney and the collargol entered directly into the blood vessels of the cancer, passing from here into the general circulation and having produced a colloid silver shock. A successful nephrectomy was performed later and the patient was discharged in good condition. The accident is described to impress the fact that collargol must be completely abandoned in pyelography.—*T. Leucutia.*

NERVOUS SYSTEM

Benassi, Enrico. Contributo allo studio delle vie di communicazione fra gli spazi sottoaracnoidei spinali e le lacune linfatiche dei nervi. (Study of the routes of communication between the subarachnoid spinal spaces and the lymphatic spaces of the nerves.) *Radiol. med.*, Oct., 1933, *20*, 1321–1333.

The author emphasizes the importance of a possible exchange between the cerebrospinal fluid and the lymph which circulates in the peripheral spinal nerves. He thinks it probable that there are normal and morphologically well-defined routes of communication between the subarachnoid spaces around the spinal roots and the lymph spaces of the nerves. He cites a case in support of this opinion. Lipiodol was injected in a boy of thirteen for the purpose of myelography. It was arrested at the level of the 2d to 5th lumbar vertebrae; after a few hours several of the spinal roots were injected. A roentgenogram taken thirteen days later showed injection of several sacral and lumbar nerves. Many of the nerves of the sacral plexus were distinctly shown. There was clinical improvement but after several months pain developed, probably due to irritation of the meninges and nerves by the iodized oil. This case is a very unusual one both with respect to the large number of nerves injected and the promptness with which the injection took place. —*Audrey G. Morgan.*

Camp, John D., Adson, Alfred W., and Shugrue, John J. Roentgenographic findings associated with tumors of the spinal column, spinal cord, and associated tissues. *Am. J. Cancer*, Feb., 1933, *17*, 348–372.

The authors state that a careful roentgen examination of patients with spinal cord tumors has assisted in detecting the presence of these lesions much earlier, so that the ratio of operable to inoperable tumors, as shown by recent studies, is now approximately 80 to 20, with a surgical mortality of 4 per cent.

Spinal cord tumors may arise from many of the primary tissues, and these tissues may become the field of metastatic implants. Many tumors that arise within the spinal canal are considered amenable to operation, since those that arise from nerve roots, and meninges, and blood vessels are encapsulated, usually nonmalignant, and removable. Intramedullary tumors are less amenable to surgical treatment, but ependymal cell tumors of the filum terminale frequently can be removed.

Proliferative changes in the laminae, pedicles, spines, and bodies of the vertebrae, and in the intervertebral discs; may give rise to compression of the spinal cord, simulating that caused by tumors arising within the spinal canal.

The authors state that primary and secondary changes in the bone produced by tumors, produce changes on the roentgenogram that can be demonstrated in 15 to 20 per cent of cases in which tumors arise from tissues within the spinal canal.

Roentgenoscopic and roentgenographic studies with radiopaque oil have furnished additional information leading to localization of small tumors before positive neurologic symptoms have developed.

The authors describe the indications and contraindications for the use of radiopaque oil.

The roentgen examinations include anteroposterior and lateral roentgenograms supplemented by stereoscopic and oblique views at the level at which the tumor is suspected.

In the interpretations of roentgenograms one is concerned chiefly with alterations in the structure of the vertebrae or adjoining rib.

Primary or metastatic disease of a vertebra exhibits the same characteristics as the condition in other bones, except as these may be in-

fluenced by the contour of the vertebra and the mechanics of posture and weight bearing.

BENIGN TUMORS OF SOFT TISSUE

Neurofibroma. Neurofibromata arise from spinal nerve roots and are intrameningeal, extrameningeal, or extend along the course of the nerve, producing a tumor which has the shape of a dumbbell, with intrameningeal and extrameningeal portions. The extrameningeal extensions may erode through the intervertebral foramen to form large extravertebral masses. These occur more commonly in the cervical and thoracic portions of the spine. The earliest roentgen manifestations are the thinning of the mesial border of one or both pedicles of the vertebra, thinning of the lamina, and later the changes may extend to involve several vertebrae. As a tumor increases in size, erosion of the ribs, bulging of the surrounding soft tissues, and intrathoracic extension may be seen.

Endothelioma. Endotheliomas usually arise from the arachnoid villi, but they may arise from other parts of the meninges or from blood vessels. In many of these tumors calcareous psammoma bodies develop. Roentgenologically, the tumors simulate neurofibromas.

Fibroma. Fibromas occur less frequently than neurofibromas and endotheliomas. The roentgenographic findings are similar to those discussed above.

Hemangioblastoma. These tumors arise from blood vessels, they grow slowly and, because of their vascularity, produce erosive changes in the laminae, pedicles and bodies.

MALIGNANT TUMORS OF SOFT TISSUE

Intramedullary Tumor. These tumors arise from the substance of the spinal cord and rarely produce roentgenographic changes.

Lipomas. These produce changes similar to those of other intramedullary tumors.

Ependymal Cell Glioma. These tumors arise from the cells lining the central canal and are most commonly found in the conus and in the filum terminale. They may produce extensive erosion of the laminae, pedicles, and bodies of the vertebrae. These tumors erode and expand the bone by direct pressure and the margins of the eroded bone are sharp and well defined. Absorption of the laminae may lead to an erroneous diagnosis of spina bifida occulta. When the tumor is limited to the sacral region the changes may be confused with those of a large giant cell tumor. In giant cell tumor of the sacrum the multilocular cysts are a part of the bone itself, whereas in ependymal cell glioma of the sacral region the well-defined pseudocysts are produced by expansion and erosion of the bony surroundings of the spinal canal.

Chordoma. These tumors arise in the region of the sacrum and are mesenchymal in origin. Roentgenograms reveal infiltrative erosions of the sacrum which may result in complete destruction of the laminae and spinous processes and even extend into the ischium and in some instances through the body of the sacrum into the pelvic cavity. They may be imitated by metastatic malignant growths.

Dermoid tumors arise in the region of the sacrum, are capable of producing localized erosions but rarely invade and destroy the laminae and spinous processes and they are usually found in the anterior portion of the sacrum.

BENIGN TUMORS OF THE VERTEBRAE

These tumors include osteomas, osteochondromas, chondromas, fibrochondromas, foreign body and giant cell tumors and hemangiomas.

MALIGNANT TUMORS OF THE VERTEBRAE

These tumors include myelomas and sarcomas. The authors also discuss tuberculous lesions simulating spinal cord tumors, spinal erosions secondary to aneurysm and bony and cartilaginous proliferations, producing compression of the spinal cord.

In the discussion of the examination by means of radiopaque oil, the authors stress the fact that the patient must be examined in the prone and supine positions in order to obtain information about the anterior and posterior aspect of the spinal cord.—*E. P. Pendergrass.*

SKELETAL SYSTEM

JETER, HUGH, and MCGEHEE, CHAS. L. Osteopoikilosis. *J. Bone & Joint Surg.*, Oct., 1933, *15*, 990–992.

The authors have found only 19 cases of osteopoikilosis or osteopathia condensans reported in the literature, and report an additional case. Their patient was a white male, aged thirty-seven. The roentgenographic examination of the skeleton revealed multiple areas of increased density of bone, most numerous about the metaphyses and in the epiphyses of the bones of the feet, hands, arms and legs, with a few such areas in the pelvic bones and the scapulae. The bones of the spine, ribs and

skull showed no evidence of such changes. The areas of density were irregular in outline, but roughly round, fairly well circumscribed, and ranged from 0.5 to 10 mm. in diameter.—*R. S. Bromer.*

Leopold, Jerome S., and Castrovinci, Frederick. Cleidocranial dysostosis. *Am. J. Dis. Child.*, July, 1933, *46*, 113–118.

The syndrome of cleidocranial dysostosis, first described by Marie and Sainton in 1897, is characterized by (1) an aplasia, more or less marked, of one or both clavicles; (2) exaggerated development of the transverse diameter of the cranium; (3) a delay in the ossification of the fontanel; (4) hereditary transmission.

The clavicular deformity is the most essential feature; the other three criteria may or may not be present. The deformity of the cranium, rather marked in some cases, is not incompatible with changes attributable to rickets. The various types of clavicular deformity are very aptly explained by variations in the anatomic development of the bone. The authors' case is deemed atypical by them because of the symmetrical nature of the clavicular lesion and the presence of a calcified nodule just medial to the acromial portion of each clavicle.

The following points were noted on roentgen examination: (1) A bilateral, symmetrical separation of both clavicles was present at approximately the same point, corresponding to the deltoid tubercle. (2) The lateral ends of the sternal portions were rounded and directed upward and anteriorly. (3) The acromial portions were directed downward and posteriorly. The medial end of each acromial portion was also rounded and smooth. (4) At about 0.5 cm. from the medial end of each acromial portion was a small, calcified nodule. On roentgenoscopic examination this was found to be united to the acromial portion. The calcified nodule was of the same size on both sides. (5) The sum of the length of the medial portion (0.5 cm.) and the lateral portion (5.5 cm.) corresponded to the length of a normal clavicle for a child of the age of the patient. (6) Except for the break in continuity of both clavicles, no pathologic condition of the bones of the vertebrae or ribs was present.

The clavicle may be considered to arise from two centers of ossification, at first developing from the investing membrane and subsequently also from the chondrified connective tissue. These two centers subsequently become united by the development of a third center lying between the two. The third center grows entirely from the membrane, no cartilage cells being present. In their case, the authors consider that development from the sternal and acromial centers has proceeded to completion, whereas the third connecting center has failed to unify ossification. This, however, in no way tends to explain the lack of fusion. The small calcified area seen in the roentgenogram may represent the third center of ossification. According to another explanation, the small calcified nodule may represent a small sesamoid bone lying in the fibrous connection extending between both segments of each clavicle.

Although their case does not fulfill all the criteria of Marie and Sainton, the prominence of the forehead, the tapering fingers and the history of delayed closure of the anterior fontanel point to other bony deformities. Their case also had no history of heredity. The presence of the calcified nodule at the medial end of each acromial segment suggests that all these cases deal primarily with some unknown force which interferes with the ossification centers of the clavicle. The dermal and chondral origin of bone is possibly a secondary consideration.—*R. S. Bromer.*

Platt, Harry. On some complications of traumatic dislocation of the hip-joint. *Brit. J. Surg.*, April, 1932, *19*, 601–605.

Following an uncomplicated dislocation of the hip-joint, the restoration of perfect function is the rule, but in certain circumstances the prognosis may be profoundly modified by the occurrence of complications which usually date from the time of the accident, but on occasion may arise during the early stages of treatment. The most important of these complications are: (1) fractures of the acetabulum, or head of the femur, and (2) involvement of the sciatic nerve.

Case reports are given on four cases:

Case 1. Posterior dislocation of the right hip. Fracture of the acetabular rim. Extrusion of loose fragment per vaginum.

Case 2. Posterior dislocation of the right hip. Sciatic nerve involvement. Myositis ossificans.

Case 3. Posterior dislocation of the left hip. Fracture of the head of femur. Fracture of acetabular margin. Sciatic nerve involvement.

Case 4. Traumatic dislocation of the right hip. Fracture of acetabular margin.—*W. C. Hall.*

SNOKE, PAUL O. Vertebral epiphysitis and osteochondritis. *J. Bone & Joint Surg.*, Oct., 1933, *15*, 963–969.

Snoke says his object in this paper is to review the work of Scheuermann and Schmorl as read in the original language and to present 3 cases of dorsal kyphosis with comments thereon.

From Scheuermann's original article he quotes the following description of a clinical entity, "Die Lehrling's Kyphose" (The Apprentice's Kyphosis):

1. Clinical—Round back (dorsal kyphosis); painful back; irreducible deformity (contradistinction of dorsum rotundum); found especially in males from four to eighteen years of age.

2. Roentgenographic—An area of osteitis on the diaphyseal side of the epiphyseal line; wedging of vertebra in the dorsolumbar region.

From Schmorl's description he quotes the following:

1. "Ausbuchtungen" (outpouchings of the nuclear substance into the spongiosa) because of

2. Congenital or traumatically produced orifices in the cartilaginous plate.

3. The kyphos is the result of loss of nuclear substance, which interferes with the physiological function of the spine, causing

4. Failure of endochondral growth in the cartilaginous interface and wedging. Schmorl does not use the term osteochondritis.

Snoke arrives at two conclusions: 1. Schmorl saw the termination of the disease Scheuermann described. There exists, however, a gap in our knowledge in that the subsequent course of Scheuermann's cases is not known. It would be invaluable if the 86 cases he reported could be traced and re-examined eleven years after their original observation. 2. There may be three or more separate diseases or manifestations of the same disease which, until the present time, have not been separately identified. As Evans suggests, there may be three pathological entities: (*a*) vertebral epiphysitis (Scheuermann), (*b*) osteochondritis of the cartilaginous interface (Schmorl), (*c*) a combination of these two. It is not to be supposed that only these three exist, or that they represent three etiological entities. They may or may not simply present roentgenographic evidence of pathological changes of several origins.

In the 3 cases he reports, Snoke makes a differentiation based upon the occurrence of the disease in two places; one, the diaphyseal side of the epiphyseal line on the interfaces of the vertebral bodies; two, the prolapse of the nucleus pulposus due to pathological changes in the cartilaginous plate, probably an osteochondritis. From a medicolegal point of view it is important to note the onset of symptoms which were not amenable to treatment following a definite trauma.—*R. S. Bromer.*

KLEINBERG, SAMUEL. Prespondylolisthesis; its roentgenographic appearance and clinical significance. *J. Bone & Joint Surg.*, Oct., 1933, *15*, 872–881.

Kleinberg reports 9 cases of prespondylolisthesis, a condition in which there is a laminar defect of congenital origin in the last lumbar vertebra without displacement of any of its segments. Roentgenograms reveal the pathology of the condition. In the anteroposterior view the vertebrae appear normal as a rule. In the lateral view, one sees a vertical or slightly oblique defect of the pedicles between the articular processes of the last lumbar vertebra, separating the body and the superior articular process in front from the inferior articular process and the neural arch posteriorly, exactly as one finds in a spondylolisthesis. The alinement of the lumbar vertebrae and the sacrum is entirely undisturbed. The osseous defect varies in width from approximately a sixteenth of an inch to an eighth of an inch. The outlines of the adjacent bony surfaces are irregular. There is no sign of any new bone deposit. The defect is sometimes seen more clearly in an oblique view. In a little over half of the cases there is an exaggeration of the lumbosacral angle, with the sacrum sometimes almost horizontal and the lumbosacral plane nearly vertical.

This condition is a competent cause for backache and back disability. It is the forerunner of spondylolisthesis. It may remain asymptomatic for many years, or throughout life. The most active period of life, thirty to fifty years, has shown the largest incidence in the author's group of cases. The chief clinical features are low back pain, stiffness of back, sciatic pain, localized tenderness at the lumbosacral area. Lordosis is often present but is not a constant finding. The most effective treatment is surgical, consisting of a fusion of the lower three lumbar vertebrae to the sacrum.—*R. S. Bromer.*

Burman, Michael S., and Sutro, Charles J. A study of the degenerative changes of the menisci of the knee joint, and the clinical significance thereof. *J. Bone & Joint Surg.*, Oct., 1933, *15*, 835–861.

Authors' Conclusions. Degeneration of the menisci of the knee joint occurs as a typical change of progressive age. The severity of degeneration does not always parallel age. This degeneration is noted equally in both menisci, and in menisci which have been surgically removed, as well as in menisci which have remained intact in the knee. The term "meniscosis" is suggested to describe the degenerative changes which the meniscus undergoes. The exact relation between degeneration of the meniscus and the alteration of the blood vessels described is quantitatively uncertain. The menisci tend to regress under several factors which include daily small traumata of subclinical import, poor vascularity quite independent of vessel pathology, the presence of intra-articular disease, vessel alterations which are so frequently present, and probable alterations in synovial nutrition. Hempel has indicated that cartilage may be destroyed by ferments in the synovial fluid. If this is true, this may hold true for the menisci, which receive some nutrition from the synovial fluid.

Meniscitis does not exist as an entity. Meniscosis need not express itself clinically; though rarely, in the later decades of life, it may be the cause of pathological fracture of the meniscus, in a patient without a history of trauma or in association with arthritis. Meniscal cysts are degenerative in orgin.—*R. S. Bromer.*

Bistolfi, Stefano. Contributo allo studio delle ossificazioni traumatiche para-articolari: le ossificazioni paramalleolari. (Study of traumatic para-articular ossifications: paramalleolar ossifications.) *Arch. di radiol.*, 1932, *8*, 566–604.

The author describes and illustrates with roentgenograms 27 cases of ossification in the region of the ankle joint due to trauma. These lesions are not particularly frequent as in addition to these he has seen only 5 others, making a total of a little over 30 among the 3,200 cases of trauma of the ankle examined during the past seven years, or about 1 per cent. They are often of considerable medicolegal importance in assessing compensation for the pain and functional disability.

The cases are divided into three groups. They are generally the result of sprain of the ankle. After a varying period of time they cause pain and various degrees of functional disturbance. The roentgenogram shows ossifications analogous to the paracondyloid ossifications of the knee joint caused by trauma. As they are generally near the malleoli he suggests the name of paramalleolar ossifications instead of the one of paratibial calcifications generally used. In the first group the ossification is in the surrounding soft parts and not directly connected with the ligaments or joint tendons. It results from the calcification and ossification of hemorrhagic foci from laceration of the soft parts. The functional disturbance is less in this than in the other two groups. In the second group the ossification affects the tendons, resulting in limitation of active movements of the muscle affected but no limitation in the passive movements of the joint. The ossification can be seen along the tendon in the roentgenogram. In the third group the ossification is in the joint ligament itself. It is a bone metaplasia of the fibers of the ligament. It may cause considerable disturbance in the function of the joint, particularly in walking, and this must be taken into consideration in judging the late effects from the medicòlegal point of view.

In all the cases, even when they eventually recover, as they generally do, particularly the first group, pain may persist for a long time, as is natural in a process of metaplasia in tissues subjected to constant friction; the process is not visible in the roentgenogram until some months after the injury.—*Audrey G. Morgan.*

Vajano, Domenico. Su di un caso di frattura isolata dell' apofisi tibiale posteriore. (A case of solitary fracture of the posterior tibial process.) *Arch. di radiol.*, 1932, *8*, 426–434.

Destot calls the inferior and posterior third of the distal epiphysis of the tibia the posterior tibial process, or the third malleolus, though it is not anatomically independent of the rest of the tibia and does not have an independent center of ossification. It is not mentioned under a separate name in the textbooks of anatomy. The posterior surface of the body of the astragalus fits into its anterior curvature and so it forms a firm support against backward luxation of the foot in all sudden movements of the foot such as jumping and running. It is not generally fractured alone but in association with fracture of the malleoli. So far as the

author knows, only 3 cases of solitary fracture of this process have been described. He describes one in which he was called on to render a medicolegal opinion.

The patient was a man of twenty-seven who fell from a height striking with the weight of his body on his right foot. There were only slight abrasions of the skin, swelling and ecchymosis, and in a few days he went back to work. About a year later he came for roentgen examination with a view to claiming compensation. He complained that he became tired quickly on walking and had pain on change of weather. There was slight swelling of the right ankle, most marked at the right malleolus, and some pain on pressure. The position of the foot was not abnormal; there was some limitation of the movements of extension, flexion and rotation. Roentgen examination clearly showed a shadow about 0.5 cm. broad and 2 cm. high at the lower end of the tibia, ending above in a small spur. In the postero-inferior region of the epiphysis of the tibia there was a defect the size and shape of this shadow. Apparently this was an isolated fracture of the posterior process of the tibia, or third malleolus with displacement of the fragment.

This fracture in itself is not very serious but when associated with fracture of the malleoli it may become very serious, resulting in backward subluxation of the foot and equinism.—*Audrey G. Morgan.*

DODD, HAROLD. Pied forcé or march foot. *Brit. J. Surg.*, July, 1933, *21*, 131–144.

March foot is a subacute painful affection of the fore part of the foot, occurring chiefly about the shafts of the metatarsals and the surrounding soft parts. It develops insidiously with slowly increasing pain which ultimately becomes continuous and incapacitates its victim. Soldiers carrying full packs and civilians engaged in similar heavy occupations are affected. With the present day ample mechanical facilities this disease is becoming rarer.

The swelling appears on the dorsum of the foot, centered usually about the shafts of the second and third metatarsals, invading the soft tissues and bone. A bony swelling of the shaft of one of the metatarsals, usually the second or third, becomes palpable several weeks later. This is callus, which has arisen usually around an oblique or V-shaped fracture of the metatarsal shaft, at the junction of the middle and distal thirds. This fracture occurs quietly without noticeable incident as the condition develops; it is not an exciting factor and is not always present. Crepitus may be detected at the site of the swelling.

Roentgen examination shows a bony swelling of somewhat fluffy, bulbous outline, due to callus, at the junction of the distal and middle thirds of either, and occasionally even of both of the shafts of the second or third metatarsals. This swelling is around a fracture. In the early stages there is increased density of the shafts of the metatarsals where the interosseous muscles arise. All show signs of weak architecture.

The bony swelling, microscopically, consists of calcified osteoid tissue with periostitis. It forms at the junction of the middle and distal thirds, this point being the site of entry of the nutrient blood vessels.

The diagnosis is suggested by: The patient's occupation; the history of incapacitation due to pain in the fore part of one or both feet; the presence of a swelling partly of the soft tissues and also of the bone about the metatarsal shafts; occasionally crepitus detected in the metatarsal, which is the seat of the swelling; the roentgen picture; and the progressive recovery which follows rest, adequate support, and care of the feet.

The treatment consists in: Rest in bed until the pain and edema subside, with complete immobilization of the foot or feet by plaster in a position of dorsiflexion and inversion; careful fitting with stout shoes or boots which adequately support the feet and so adjusted with inside wedges to the heel and sole, metatarsal bars, or even an outside iron with an inside T-strap if necessary.

Patients are carefully instructed in the toilet and care of the feet, a card with printed instructions concerning this care being given to them.—*J. R. Andrews.*

GENERAL

SWANSON, W. W., FORSTER, W. G., and IOB, VIVIAN. Calcinosis circumscripta. *Am. J. Dis. Child.*, March, 1933, *45*, 590–593.

Calcinosis is defined as the occurrence of calcium deposits in the skin, subcutaneous tissues and in the deeper structures where such deposits are not normally found. The authors report the case of a white baby girl, first observed ten days after birth. About four weeks later the mother drew attention to peculiar

hard nodules in the subcutaneous tissues which began at the knees and extended up the thighs, including the buttocks, and laterally to the iliac crests. The masses were unevenly distributed around the thighs and hips. Frequent roentgenograms were made during the period in which the child was under observation which showed the dense calcifications. It is probable that the nodules became more discrete as the child grew. The last roentgenogram taken when the patient was eight months old showed complete absorption of the calcified nodules.

It is impossible to explain the occurrence of these nodules in a healthy normal infant. No inflammatory changes were observed, and it is impossible to believe that there could have been such an extensive degeneration of tissue cells where calcification did occur. The most interesting thing, the authors regard, is the fact of the disappearance of the nodules within eight months. No therapy of any kind was used.—*R. S. Bromer.*

ROENTGEN AND RADIUM THERAPY

D'Emido, Angelo S. La radiumterapia dei fibromi nasofaringei. (Radium therapy of nasopharyngeal fibromas.) *Arch. di radiol.*, 1932, *8*, 789–795.

Nasopharyngeal fibromas are benign but they are very serious because of their enormous power of penetration, the severe hemorrhages that they sometimes cause, the difficulty of surgical removal and their frequent recurrence after operation. The author reports 2 cases treated by radium therapy with success. The tumors had been removed surgically but had recurred so that there was as large a tumor mass as before the operation. Rubber tubes containing 10 mg. radium filtered through 2 mm. platinum were inserted into the nasal cavity under novocain anesthesia and gradually pushed farther in until they penetrated the pharyngeal cavity. The 2 mm. platinum filter protects from necrosis. One or two tubes may be used and the irradiation continued for eight to eleven days. Large doses are indicated in these cases and the irradiation should be continued until erythema of the vault of the palate, the soft palate and the tongue appears. This is manifested by the appearance of white spots from necrosis of the superficial epithelium. The total dose given in these cases was 20–30 mcd. In one of the cases the treatment had to be repeated after 8 months. In the other a single treatment was sufficient. The tumors disappeared completely though gradually and the patients are free of recurrence after two years. The author does not advise diathermic coagulation in these cases as there is serious danger of hemorrhage and necrosis. Radium therapy by protracted fractional irradiation is the method of choice.—*Audrey G. Morgan.*

Levin, Samuel J. X-ray treatment of inflammatory conditions in childhood. *J. Pediat.*, March, 1933, *2*, 312–317.

Favorable results have been reported from the roentgen irradiation of pertussis, asthma, pneumonia, unresolved pneumonia, acute lymphadenitis, parotitis, otitis media, mastoiditis, cellulitis, erysipelas and pyogenic skin infections occurring in children. No deleterious effects have been noted when proper technique and correct dosage have been employed. Levin found roentgen therapy especially satisfactory in acute lymphadenitis and early mastoiditis and feels that the method is deserving of greater and more widespread trial.—*W. R. Brooksher.*

Davis, A. A. The treatment of Dupuytren's contracture. *Brit. J. Surg.*, April, 1932, *19*, 539–547.

The author reviews 31 cases of Dupuytren's contracture. An analysis of the group brought out the following points: (1) The average age of all patients was fifty-four years. (2) There were 30 males and 1 female in the group. (3) Both hands were affected in 58 per cent of cases. The right hand alone was affected in 22 per cent of cases, and the left hand alone in 20 per cent of cases. Ninety per cent of the cases were right handed. (4) The average duration of the disease before operation was seven years. (5) The majority of patients in the group were manual laborers.

The etiology of Dupuytren's contracture remains obscure.

Mechanical methods of treatment, including fibrolysin and radium and roentgen therapy, are useless, with the proviso that further experience may conceivably make radium a safe and effective cure. Operation of some type remains the method of choice in treatment, and the minor operation of multiple subcutaneous fascial division should be adopted, and repeated if necessary, in the average patient of the hospital class, since major operative procedures are far

from satisfactory. In patients of the more leisure class, wide fascial excision with replacement of involved skin by a free full-thickness skin graft is probably most advisable, combined, if necessary, with Hutchinson's operation. Where the best cosmetic result is desired, Thiersch grafts may be substituted for the thicker full-thickness ones. Implants of fat or fascia are theoretically undesirable, and have not been uniformly successful in application.—*W. C. Hall.*

TOMLINSON, C. C., and BANCROFT, PAUL. Granuloma coccidioides. *J. Am. M. Ass.*, Jan. 6, 1934, *102*, 36–38.

Brief reports of 3 cases of granuloma coccidioides are given, one being a review and progress report of a formerly reported case. The authors believe apparent cures were effected in 2 cases treated by antimony and potassium tartrate and local doses of roentgen rays. (In Case III death interrupted treatment following early improvement.) The roentgen treatment consisted of about 10 doses of one-fourth to one-half skin unit of unfiltered rays applied at intervals of seven to thirty days. One per cent solutions of the chemicals were given intravenously in 64 doses of 5 c.c. each over a period of 184 days.—*E. W. Hall.*

FECI, LORENZO. Roentgenterapia delle metastasi ossee da carcinoma della mammella. (Roentgen therapy of bone metastases of carcinoma of the breast.) *Arch. di radiol.*, 1932, *8*, 1–14.

The author describes a case in a woman aged fifty-six, who presented a bone metastasis in the frontal bone following an operation three years before for carcinoma of the breast. She was given one series of roentgen irradiations through four fields, two frontal and two lateral, with an anticathode-skin distance of 50 cm., a filter of 0.6 mm. copper and 2 mm. aluminum, 180 kilowatts, 2 ma.; time 25 minutes per treatment. The four treatments were given on alternate days for a week, the total dose being 600 r per field. The pain was relieved almost immediately and the exophthalmos more slowly. The patient is now completely well more than two years after the treatment. A number of roentgen examinations have shown complete reduction of the tumor and marked but not complete calcification of the osteoclastic areas. Further treatment might have been given but the patient felt so well that she refused further irradiation.

The patient had been given roentgen treatment before and after the breast operation and the author thinks this was probably a part, at least, of the reason for the great radiosensitiveness of the bone metastasis. Bone metastases in general are only moderately radiosensitive.—*Audrey G. Morgan.*

CAMPLANI, M. Un quinquennio di terapia del cancro colle radiazioni. (Five years' treatment of cancer by irradiation.) *Arch. di radiol.*, 1932, *8*, 92–107.

The author reports the results of radiotherapy, chiefly with radium, at the hospital in Bergamo during the past five years. They include 48 cases of skin cancer, 15 of the lip, 19 of the mouth and cheek, 10 of the floor of the mouth, 4 of the tongue, 8 of the tonsil, 16 of the larynx, 8 of the rectum, all inoperable, 57 of the cervix, 6 of the vulva, 2 of the prostate, 51 of the breast and 45 miscellaneous cases of the esophagus, thoracic cavity, internal ear, hematopoietic system, etc., all of which were hopeless and the treatment only palliative. A total of 106 cases are living, besides the ones that have been lost sight of.

Irradiation was generally given over a region extending a considerable distance beyond the actual tumor. Apparatus of Columbia paste were used containing foci of 5 mg. radium element with a primary filtration of 1 mm. platinum and at distances varying from 7 to 20 mm. with doses varying from 2 to 5 or 6 mcd. per square centimeters of surface. The filtration was increased to 1.5 mm. platinum for tumors lying near the eyeball. Needles were also used in some exuberant tumors. Further details of technique and results are given under the different groups. The results were good in operable cases, particularly in those treated early.—*Audrey G. Morgan.*

MARTIN, HAYES E. Radiation therapy in skin cancer. *Am. J. Cancer*, Nov., 1933, *19*, 605–621.

Neoplasms of the skin present fewer technical difficulties in treatment than those more deeply situated and thus the treatment of these offers an excellent opportunity for the clinician to familiarize himself with the effects and advantages of the various technical methods and with some of the physical principles governing radiation therapy. The sources of radiation

available are radium and roentgen rays. The different physical factors governing the use of these agents, which may be varied for this purpose are: (1) area of radiating surface or size of skin portal, (2) distance, (3) filtration, (4) for roentgen rays, voltage, and (5) for radium, the use of interstitial instead of external application.

The area of the radiating surface of an applicator, or the size of the skin portal, should be the same as or only slightly larger than the superficial lesion to be irradiated.

With regard to distance, contact or very short distance applications are the most effective for superficial lesions but if the lesion is 1 cm. or more in thickness contact application is very ineffective. For lesions 1 cm. or more in thickness, the applicator should be at a greater distance, interstitial implants should be employed, or if the tumor projects above the surface of the skin, irradiation may be preceded by removal by endothermy of a portion down to the skin level.

With regard to voltage, for treatment of superficial lesions, where it is desirable that the effect shall be confined to the first few millimeters of tissue, the soft rays from either radium or roentgen rays are among the most valuable agents.

Interstitial irradiation: By interstitial irradiation the closest approximation to the ideal localized effect can be obtained. By this means alone can one be assured that a tumor mass situated below normal tissues receives more irradiation than any adjacent normal tissue. The author prefers the Memorial Hospital's standard interstitial applicator, the gold seed (4 mm. long, 0.7 mm. diameter, 0.3 mm. gold filter).

Technical methods: In the average cancer of the skin, the dose, however large, should be administered in one sitting. If this dose must be repeated, or supplemented, the original treatment must be classed as a partial failure. Skin lesions are treated by means of the following sources of radiation:

Distance applicators.

1. Roentgen rays, 140 kv., 4 or 5 ma., 1 mm. Al or no filter, 20 to 25 cm. distance.

Intermediate applicators.

2. Radon tray, 20 sq. cm. area, 3 cm. distance, 3 mm. brass filter (equivalent).

3. Radon plaques, 1 cm. distance, 3 mm. brass filter:

(*a*) Square plaque, area 1.8 by 1.8 cm.
(*b*) Long plaque, area 1.7 by 2.7 cm.
(*c*) Round plaque, diameter 4 cm.

Surface applicators.

4. Platinum gold radon tubes, 1.6 cm. long, 1.5 mm. diameter, 0.5 mm. wall thickness, 2 mm. brass filter (equivalent).

5. Bulb, no filter.

Interstitial applicators.

6. Gold seeds, 0.3 mm. filter.

The author then describes in detail the practical application of these various agents. The author cites many cases and this section of the paper is worthy of study but does not lend itself well to abstracting.—*J. R. Andrews.*

Fucci, Nicola. Contributo clinico sul valore della Roentgen terapia ipofisaria nel diabete mellito; influenza delle irradiazioni sul ricambio idrocarbonato e sul quadro ematologico. (The value of roentgen irradiation of the hypophysis in diabetes mellitus; effect of irradiation on carbohydrate metabolism and the blood picture.) *Arch. di radiol.*, 1933, *9*, 481–528.

Four cases of diabetes mellitus are described together with the methods of examination used to determine the degree of disturbance of carbohydrate metabolism and the clinical forms of the diabetes. Three of the cases were definitely shown to be pancreatic in origin. In all of these cases functional and morphological examinations showed that there were no appreciable lesions or dysfunction of the hypophysis.

The patients were then given deep roentgen irradiation of the hypophysis through temporal fields. The effect of the irradiation on carbohydrate metabolism and on the blood picture was studied. It was found that irradiation of the hypophysis did not give good results in cases of pancreatic diabetes in which there was no hypophyseal factor—in fact, the condition was aggravated in these cases. Therefore the author disagrees radically with Vespignani's advice to use roentgen treatment in all cases of diabetes.

The blood examination showed hyperglycemia, hyperleucocytosis and increased blood pressure, both maximum and minimum; the author believes these blood changes are due to a tonic action of the irradiation on the vegetative nervous system.—*Audrey G. Morgan.*

HAAS, HANS. Morbus Basedow und unmittelbarer Todesfall nach der Röntgenbestrahlung. (A case of immediate death in Basedow's disease after roentgen irradiation.) *Acta radiol.*, Feb., 1934, *15*, 62–68.

A case is described in a woman of fifty-two who was given roentgen irradiation for severe Basedow's disease. She was given 5 per cent of a skin erythema dose distributed over 3 fields on each of four days, March 23, 24, 25 and 27, and she died on March 31. This was a death directly due to irradiation in Basedow's disease and was evidently caused by the effect of the irradiation on the blood. On admission there was a slight lymphocytosis with shifting to the left of the myeloid series, the blood picture of a moderately severe Basedow's disease and not a contraindication to roentgen irradiation. In the course of the treatment a typical agranulocytosis developed with disturbances in the erythrocyte picture and thrombopenia.—*Audrey G. Morgan.*

EVANS, WILLIAM A., JR. Histological factors in the prognosis of mammary cancer treated by radical operation and x-rays. *Am. J. Cancer*, Oct., 1933, *19*, 328–338.

The author renews the discussion as to the possibilities of histological prognosis in malignancies of the breast. His analysis of the statistics with reference to histology and prognosis reveals the absolute uncertainty of our present grouping. Scirrhous carcinoma, medullary carcinoma, and adenocarcinoma are diagnostic headings and should not be utilized as such in determining the outcome of a particular case. Evans refers to the work of Salomon, Boss, Feist and Bauer, Greenough, Linder, and Lewis and Rienhoff, demonstrating the inadequacy and futility of using such methods.

The author had at hand a group of 75 cases who had been treated by radical operation and by postoperative short wave length radiation. His plan of attack was to study the specimens from the cases, with a separate analysis of the various factors which from time to time have been considered of prognostic value. These were grouped into factors of offense and defense.

Fibrous tissue reaction, lymphocytic infiltration, and local eosinophilia are usually classified as defensive factors. The author feels that there is no convincing evidence that fibrosis has anything to do with the final outcome in cancers of the breast. On the other hand, there is good evidence that lymphocytic infiltration carries with it an unfavorable prognosis.

Listed as factors of offense are tubule formation, characteristics of the cytoplasm, irregularities of cells, and the frequency of mitoses. Evidence of tubule formation is indicative of a favorable prognosis. On the basis of the percentage of patients alive after five years, there seems to be a slightly greater malignancy of a process containing cells with a high nucleocytoplasmic ratio and poorly staining cytoplasm. The greater irregularity in the size and shape of cells indicates greater malignancy and a poorer prognosis. The author's studies also indicate that no prognostic value can be attached to the presence or absence of mitotic figures.

The bibliography contained in the article is most satisfactory.—*P. J. Hodes.*

BUSCH, K. F. B. Results of treatment of uterine cancer at the Aarhus Radium Center (Denmark). *Acta radiol.*, 934, *15*, 47–61.

The author gives a statistical report of the cases of uterine and vaginal cancer treated at the Radium Center in Aarhus (Denmark) from 1914 to 1931, including 653 cases of cancer of the cervix, 63 of the body of the uterus and 17 of the vagina. His statistics are divided into two parts, the material with five years' observation time being analyzed in detail according to the rules of Winther for work of this kind, while the more general statistical material includes all the cases for the whole period. For the sake of comparison with a larger material he gives in parenthesis the corresponding figures of a statistical report from Munich.

In the Aarhus statistics the rate of absolute cure for the four cases of cancer of the cervix is 17 per cent as compared with 22 per cent for Copenhagen and 18.2 per cent for Munich. For cancer of the body of the uterus the rate of absolute cure is about 40 per cent at both Aarhus and Munich.

In a group of cases treated by surgery and postoperative irradiation the rate of cure was about 10 per cent.

Careful and sufficient after-treatment is important in the cases as shown by the fact that the rate of cure for middle class patients was about 10 per cent higher than for working class patients owing to the fact that the latter are unable to get the rest, good food and hygienic care required.

The method used at Aarhus in the treatment of cancer of the cervix is as follows: If the pa-

tient's condition makes it possible a radium tube is inserted in the uterus on the day after admission and a radium capsule is applied against the portio vaginalis. This treatment is repeated after ten days. The radium is tamponed off from the rectum in order to prevent rectal complications. Since 1927 such complications have been very rare. A total dose of 3,000 mg-hr. is given in the uterus and 4,000 mg-hr. in the vagina. After one month the patient returns for roentgen treatment. In the course of this treatment 1,000 r is given over each parametrium: filter 1 mm. aluminum and 1 mm. copper, 4 ma., 160 kv. The dose is given in five sittings. During the next year the patient comes in for examination every second month and after that at longer intervals, but as far as possible she is never lost sight of.—*Audrey G. Morgan.*

Lauritzen, Kjell. Recurrences after five years cure in carcinoma of the cervix radiologically treated. *Acta radiol.*, Dec., 1933, *14*, 575–596.

This study is based on 1,016 cases of cancer of the cervix treated by irradiation at the Radiumhemmet from 1914 to 1925, inclusive, 222 of which were five year cures. In 1932, 163 of these 222 patients were alive without having had a recurrence. The remaining 51 cases, histories of which are given, may be subdivided as follows: 24 deaths without any sign of cancer, 27 recurrences and 2 deaths from unknown causes.

There were 12.2 per cent recurrences after an observation time of seven to eighteen years and 15.5 per cent recurrences after an observation time of ten to eighteen years. The division of the cases of recurrence into different age groups at the time of the first treatment agrees with the division of the total cervical cancer material. There is no relation between the tendency to late recurrence and the anatomical type of the tumor. There is the same frequency of late recurrences in the early and the more advanced cases. "Cancer-free" deaths occur proportionally more frequently in the more advanced cases.

The recurrences were divided as follows with reference to localization: 6 in the cervix and adjacent portion of the vagina, 2 in the corpus uteri, 10 in the connective tissue and lymph node areas of the pelvis, 2 distant recurrences, 5 cases in which it was impossible to determine the original location of the recurrence and 2 cases in which the localization was not known. Nine recurrences were manifested in the sixth year, 5 in each of the seventh and eighth years, 2 in each of the ninth, tenth and eleventh years and in each of the eleventh and twelfth years. Among the 4 recurrences in the eleventh year or later 3 were definitely and the 4th probably situated in the uterus or close to it. An attempt is made to estimate the risk of late recurrence in the different years after treatment.—*Audrey G. Morgan.*

Sharp, George S. Conservative surgical measures facilitating radium implantation. *Am. J. Cancer*, Nov., 1933, *19*, 622–637.

The author points out the fact that irradiation may fail to control epidermoid cancer of the head and neck because of the omission of certain conservative surgical procedures for exposure and drainage. He thinks that the treatment of bulky tumors may be greatly facilitated by removal of the protruding portion by one of the cautery methods under novocaine block anesthesia. Tumors are removed at the level of the skin surface with the bipolar cutting current. In this manner a radium plaque corresponding to the dimensions of the lesion may then be directly applied.

In the author's opinion, carcinoma of the lip is best treated by irradiation. In early cases he advises three surface applications of radium supplementing this with interstitial irradiation in the infiltrating type. The bulky, ulcerated, infiltrating lesions which cover large portions of the lip present a problem in themselves. These are treated with moderate irradiation, followed in a week to ten days by an extensive excision of the growth with immediate plastic repair. If involved nodes are found during the operation gold filtered radon seeds are implanted at once.

Carcinomas of the tongue and the floor of the mouth first receive rigid oral cleaning which is followed at once by external or interstitial irradiation. In general, radium is the method of choice in treating the primary growth. Surgery is desirable to gain access to the growth, to facilitate drainage, to deal with growth extension or osteomyelitis in adjacent bone, and to clean up foul, infected areas. When cervical exposure is indicated the lingual nerve may be isolated and injected with alcohol, thus allowing relief of pain and thorough cleansing. If the lesions are bulky, ulcerated, and infected, the implantation of radon is followed in seven

to ten days by cautery removal of the condemned area. In these cases the total dosage of implanted radon is high enough to compensate for the unused emanation when surgical removal is planned.

Secondary invasion of bone is a frequent finding in advanced cases of intraoral carcinoma. The radioresistant character of carcinoma in bone precludes a routine attempt to control it permanently by irradiation. Therefore a favorable response should be followed by a resection of the involved area of bone and a wide excision of the surrounding structures.

Carcinoma of the nasal accessory sinuses involves adequate surgical exposure and drainage in conjunction with irradiation. Exposure is especially necessary to provide entrance to the bony cavity to implant radium and to establish drainage of supervening infections. This is carried out under block anesthesia and the walls of the antrum exposed. Radon may then be inserted into the growth which serves as a "holder" and at a later date the entire mass can be removed. If the tumor infiltrates the floor of the orbit or invades the soft tissues, the orbit should be treated as a separate focus. A supplementary dose of interstitial irradiation is implanted in the floor of the orbit at the same time the antrum is treated. Exenteration is done with the cautery at the time of the antrotomy.

The author agrees with Quick in the treatment of epidermoid carcinoma metastases in the neck. He believes that the conditions formulated by Quick for radical neck dissection are well founded. He also believes, with Quick, that the indications for surgical exposure and implantation are increasing. Involvement of more than one node, bilateral cervical involvement, clinically adherent nodes due to perforation of the capsule, radiosensitive growths of the undifferentiated epidermoid type, recurrent disease, and poor surgical risks may be listed as indications for the latter procedure. Every case of intraoral cancer is irradiated immediately after admission using external irradiation. In those cases for whom radical dissection is decided upon, an interval of six to eight weeks is allowed before operation. Interstitial radon implantation is performed with or without exposing the affected area, though the author prefers the latter method. With the knowledge of the external irradiation received by the metastatic mass, an effort is made to implant enough radon to bring the total dosage passed into the area up to 8 or 10 skin erythemas.

The article contains details with reference to operative technique. It is interesting to note that Sharp prefers 5 per cent picric acid solution for skin preparation because it is least irritating.—*P. J. Hodes.*

SIEVERT, ROLF M. On protection against radiation in teleradium treatment. *Acta radiol.*, Dec., 1933, *14*, 597–607.

The author discusses the problem of protection in teleradium treatment. Experience in roentgen-ray treatment has shown that doses not exceeding 1/10 of a skin erythema dose per annum are harmless. But even very weak gamma radiation has been found to have biological effects.

The author thinks that in building new buildings for teleradium treatment the protection provided should be sufficient to ensure that the radiation penetrating adjacent rooms should not be appreciably greater than that which is normally present everywhere owing to the radioactivity of the earth's crust. For this reason the teleradium department should preferably be located in a basement and the author suggests the use of concrete or, when very thick walls are impracticable, iron ore concrete or, iron ore filling. By the use of these materials the thickness of the walls can be reduced to about 55 per cent of that necessary with ordinary concrete and the cost is very much less than that of using lead protection.

The author describes the teleradium department planned at Stockholm and gives the reasons for the protective arrangements proposed there.—*Audrey G. Morgan.*

MISCELLANEOUS

OMIZZOLO, F. BRUNO. Considerazioni sopra la tecnica "standardizzata" nell'esame radiologico dell'apparato respiratorio. ("Standardized" technique in the roentgen examination of the respiratory tract.) *Arch. di radiol.*, 1934, *8*, 81–91.

There is really no standard technique for roentgenograms of the thorax. Some workers advocate the use of very hard rays and some the use of very soft ones. Stephani, for instance, uses very hard rays with tensions of as high as 110 kilowatts and an amperage of from 50 to 150. Chantraine, on the other hand, uses very soft rays with only 30–40 kilowatts and as high as 400 milliamperes.

The author maintains that if the anticathode-film distance is made as long as pos-

sible, and the exposure time as short as possible good clear roentgenograms can be obtained no matter whether high tension and low amperage is used or low tension and high amperage. The distance should be at least a meter to a meter and a half. As to the exposure time, it is difficult to measure less than tenths of a second with the watches available. This gives only a relative guarantee against movement of the tissues during the exposure.

The question of technique depends partly on the apparatus available. Most of the lung examinations are not made in highly specialized laboratories but in ordinary hospitals and sanitariums where the tube is connected with the city current and is subject to variations in tension. Moreover, to obtain very hard rays an autodiffusor of the type of the rotating diaphragm should be used and these are not in common use. Therefore a tension of not more than 100 kilowatts should be used and an amperage of 40–50 milliamperes.

Roentgenograms of the lungs are generally taken standing but either a standing or a sitting position may be used. The conditions under which the roentgenogram is made should be marked on the film so that it may be used for purposes of comparison later if desired.—*Audrey G. Morgan.*

Santoro, M. Sull'uso dell'iniezione di liquidi di contrasto nei tramiti fistolosi. (The injection of contrast fluid into fistulae.) *Arch. di radiol.*, 1932, *8*, 15–25.

The author discusses the various contrast fluids used in roentgen technique and their value in solving many clinical and roentgenological problems. He then describes 3 cases in which contrast fluid was used to show the course of fistulous tracts. Such fistulae cannot always be demonstrated with sufficient clearness by sounding, and roentgen demonstration makes operation much safer and more effective. The first one was a case of fistula of the wall of the thorax following a pneumothorax treatment. The second was also a fistula of the wall of the thorax following an operation for empyema; injection of lipiodol showed that the fistula communicated with a bronchus. The injection did no harm at all. Lipiodol was used in the first case also. The third case was one of biliary fistula and as some authors have said that there is danger in the injection of lipiodol in biliary fistulas because a reflux of the fatty substance into Wirsung's duct may cause hemorrhagic pancreatitis, the author used barium sulphate in this case. This case, too, was operated on successfully as a result of the roentgen demonstration of the exact course of the tract.—*Audrey G. Morgan.*

Lovisatti, Nicola. L'influenza Röntgen sugli effetti della adrenalina nel coniglio. (The influence of roentgen irradiation on the effects of adrenalin in rabbits.) *Arch. di radiol.*, 1932, *8*, 605–616.

The author found that a dose of 2 mg. adrenalin given intravenously to rabbits is sufficient to produce death from acute edema of the lungs in 80 per cent of the cases. But if the adrenalin was given 48 hours after irradiation of the abdomen with large doses of roentgen rays it only caused death in 15 per cent (1 out of 6); all of 5 animals died, however, after irradiation of the thorax and 80 per cent (4 out of 5) after irradiation of the skull. Irradiation of the suprarenals alone did not have any influence on the effect of the adrenalin. The author thinks that this influence of irradiation on the effects of adrenalin is due to the fact that it affects the vessels either directly or indirectly through the sympathetic nervous system and keeps them from forcing out into the lesser circulation the blood that is ordinarily forced out under the action of adrenalin, thereby preventing the development of pulmonary edema. Of course there may be other nervous or humoral factors involved.—*Audrey G. Morgan.*

Capua, Antonio. Sulla encefalo-mielografia con Thorotrast. (Encephalomyelography with thorotrast.) *Radiol. med.*, Nov., 1933, *20*, 1376–1383.

The author tried the injection of thorotrast into the subarachnoid space for the purpose of encephalomyelography. He gave a suboccipital injection of 4 c.c. in a dog and obtained a good image of the sulci of the spinal cord and brain; the animal died 20 days later. Sections showed numerous changes in the arachnoid and pia mater. He also gave several injections of 20 c.c. thorotrast by means of lumbar puncture to a patient who had a tumor of the head of the pancreas with obstruction of the bile ducts and severe icterus who had been ill for over a year and was in an advanced condition of cachexia. He obtained a detailed myelogram but no picture of the sulci and ventricles of the brain. Autopsy showed numerous changes in the spinal fluid and lesions of the arachnoid and pia mater similar to those seen in the dog.

He concludes that the method is not yet ready for practical use. This conclusion is based on the fact that the dog had serious convulsive seizures evidently due to irritation of the brain cortex by the thorotrast. There were no such seizures in the human subject but the thorotrast in this case remained in the spinal canal and did not reach the cortex. He did, however, have transitory fever and severe headache and pain and contracture of the lower limbs, and these symptoms, together with the marked changes in the spinal fluid, arachnoid and pia mater indicate that the method has not yet been sufficiently perfected for practical use.—*Audrey G. Morgan.*

ANGELO, LORENZI. Sulla caduta immunitaria del potere battericida del sangue verso il bacillo di Eberth in conigli trattati con raggi Roentgen. (The decreased bactericidal power of rabbits immunized to typhoid bacilli and the effect on it of roentgen irradiation.) *Arch. di radiol.*, 1932, *8*, 435–443.

In 1926 Lusena found that when rabbits were immunized to typhoid fever by injection of typhoid vaccine the bactericidal action of their blood on typhoid bacilli was decreased. The author wished to test this finding and also determine the effect of roentgen rays on this fall in bactericidal action of the blood. He had previously found that the bactericidal action of the blood is increased by roentgen irradiation.

He vaccinated 10 rabbits with typhoid bacilli after having previously tested the bactericidal action of their blood against the same strain of bacilli. The injections of bacilli were given at intervals of five days and in the interim 8 of the animals were treated with roentgen irradiation, the other 2 being kept as controls. The bones of the limbs were irradiated with small doses, filter 3 mm. aluminum, spark gap 30 cm., 2 ma., anticathode-skin distance 30 cm., 80 kv., time 5 minutes.

He found that the bactericidal power of the blood does not fall nearly so rapidly or so completely on immunization to typhoid fever when the animals are given roentgen irradiation as when they are not irradiated. This is in harmony with his previous findings that roentgen irradiation increases the bactericidal action of the blood.—*Audrey G. Morgan.*

SPINELLI, ANTONINO. Ipofisi e ricambio grassoso. (The hypophysis and fat metabolism.) *Arch. di radiol.*, 1932, *8*, 290-311.

The author describes experiments on rabbits made to determine the effect of irradiation of the hypophysis on fat metabolism and the distribution of fat in the body. He found that irradiation of the hypophysis does have a marked effect on fat metabolism. It differs depending on whether small repeated doses with a stimulating action are used or a single large dose with an inhibiting action and on whether the animals are young growing ones or adults whose growth is finished. When small repeated doses were used both young and adult rabbits increased in weight more rapidly than the control animals. This gain in weight was due to increased weight of the bones rather than the soft parts. When a single large dose of the inhibiting type was used the results varied. Some of the young rabbits after a temporary arrest of development developed regularly like those irradiated with stimulating doses, while some did not develop as well as the control animals. There were great individual differences in the reaction of the adult rabbits. Some after having temporarily lost weight and vivacity behaved almost exactly like the controls; another after an arrest of weight for about twenty days showed a marked accumulation of fat in the subcutaneous tissue of the whole body, resulting in a gain of weight, though he lost vivacity and showed pathological changes of the hair. A long bibliography of the subject is given.—*Audrey G. Morgan.*

ROUSTHÖI, PETER. Über Angiokardiographie. (Angiocardiography.) *Acta radiol.*, 1933, *14*, 419–422.

This is a preliminary report of the author's method of angiocardiography or roentgen demonstration of the coronary vessels. In animal experiments he used both the method of direct puncture and that of catheterization of the bulb of the aorta. In angiograms of the heart the coronary circulation can be studied under normal and pathological conditions. Electrocardiograms were taken at the same time. Illustrative angiograms are given.—*Audrey G. Morgan.*

THORAEUS, R. The protective power of lead rubber. *Acta radiol.*, 1933, *14*, 424–426.

For describing the quality of lead rubber used for protecting the patient in roentgen therapy the author proposes using the percentage transmission p_m, that is the percentage amount of the incident intensity that is trans-

mitted by the lead rubber. This gives more direct information in regard to the protective power than the designation generally used.

From experimental measurements he submits the p_m values corresponding to different qualities of radiation for a number of different samples of lead rubber. He believes that the p_m of the lead rubber should not exceed 5 per cent. In the Radiumhemmet they cover the patient with a single layer of lead rubber and in addition a second layer is applied 15 to 20 cm. beyond the outline of the field. This assures a percentage transmission of not more than 5 per cent.—*Audrey G. Morgan.*

Bloch, Giorgio, and Zanetti, Serse. Nota preventiva su tentativi sperimentali di angiopneumografia. (Preliminary note on attempts at angiopneumography.) *Radiol. med.*, Nov., 1933, *20*, 1414–1415.

The attempts made thus far to demonstrate the pulmonary circulation roentgenologically have not been very successful. The authors are now working with a method which they think will prove very valuable and give a brief description of it in this preliminary note. It will be followed by a more complete description when they have worked out the method more fully. They introduce the contrast substance directly into the pulmonary artery. Two roentgenograms are given showing the introduction of the medium through an opaque sound into the pulmonary artery in dogs.—*Audrey G. Morgan.*

Benner, Sven. Strahlungsmessungen an mit radiologischen Arbeiten beschäftigtem Personal. (Measurements of irradiation on roentgen workers.) *Acta radiol.*, Dec., 1933, *14*, 623–629.

The doses of radiation received by different parts of the bodies of doctors and nurses during work in roentgen diagnosis have been measured by Sievert's condenser chamber method. The doses were generally quite small and far below the dose of 0.2 r per day which is generally accepted as the limit of tolerance. The influence of different factors on the results are discussed.—*Audrey G. Morgan.*

Griffith, Harry D. A test of some methods for calculating dosage in radium therapy. *Acta radiol.*, Dec., 1933, *14*, 608–614.

Measurements of the intensity of gamma rays in water phantoms of two different sizes are described and the results compared with computed intensities. Up to a certain distance (8 cm. for the smaller phantom and 12 cm. for the larger one) the intensity measured in water was the same as that measured in air at the same distance. For greater distances the water measurements differed from those in air and different values were found with the different types of chambers. The conditions under which calculation of dosage in roentgen therapy can be made accurately are discussed.—*Audrey G. Morgan.*

Thoraeus, Robert. Ionisation measurements of the roentgen ray output from tubes at different voltages and with different focal distances. *Acta radiol.*, 1933, *14*, 615–622.

The author gives measurements of the ionometric intensity of different voltages within the range generally used for roentgen therapy (70 to 180 kv.).

An analysis of the experimental results shows that the curves obtained for different tubes and different filters can be reproduced by the formula $i=(V/100)^y$ in which i represents the relative ionometric intensity and V the constant and continuous voltage in kilovolts. The exponent y is found to be closely related to the filter. A separate test shows that filters that are equivalent qualitatively have just the same value for y as might be expected.

As a contribution to the question of whether the ionometric intensity is inversely proportional to the square of the focus distance the author gives some measurements between 30 and 70 cm. for seven different qualities of radiation. Within the range examined the results show that there is such a proportion.—*Audrey G. Morgan.*

Moore, Robert M., William, J. Harriss, and Singleton, Albert O., Jr. Vasoconstrictor fibers; peripheral course as revealed by a roentgenographic method. *Arch. Surg.*, Feb., 1933, *26*, 309–322.

This is the report of an experimental roentgen study made to determine the vasoconstrictor pathways in the lower extremities of cats. Because of the divergent views as to the efficacy of periarterial sympathectomy as compared with sympathetic ganglionectomy, this comparative study of the results of the two procedures was made.

A modification of the method of Brooks was used; 1.5 to 2 c.c. of 100 per cent sodium iodide

solution injected into the abdominal aorta gave a beautiful delineation of the vascular tree of the lower extremity, providing the roentgenogram was taken immediately after the injection was made. Thus it was possible to compare the caliber and filling of identical vessels of the two legs.

The experiments consisted of (1) removing one lumbar sympathetic chain and eliminating the adrenal action by denerving the adrenal on the one side and removing the other adrenal body. There was marked dilatation of the vessels in the leg on the side of the sympathectomy. One animal was injected eleven weeks following operation with the same results. (2) In a second group of animals the somatic nerve trunks were severed. The sciatic was cut just below the great sciatic notch with a marked dilatation of the vessels resulting. This was most marked in the gluteal region where the muscles are not enervated by fibers from the sciatic nerve. However, section of the femoral nerve gave a vasodilator effect in only about 50 per cent of cases, indicating that the majority of the vasoconstrictor fibers are carried in the sciatic nerve. (3) In the last group of animals a periarterial sympathectomy was done upon the femoral artery which included in addition to a careful stripping of the arterial adventitia, the transverse section of all the tissue of the femoral sheath except the trunk artery, nerve and vein. In none of these animals was a vasodilation noted.

The conclusion drawn is that no great number of vasoconstrictor fibers follow along the femoral artery but rather that these fibers reach the peripheral vessels by way of the somatic nerve branching.

The article is illustrated with 11 roentgenograms.—*J. H. Harris.*

FURTH, J., SEIBOLD, H. R., and RATHBONE, R. R. Experimental studies on lymphomatosis of mice. *Am. J. Cancer*, 1933, *19*, 521–604.

The authors give the results of experimental studies made in the production of lymphomatosis in mice. This condition in mice is comparable to leucemia in man. The disease is easily transmissible to mice by subcutaneous, intraperitoneal and intravenous injections of live lymphocytic cells. The fact that the susceptibility can be markedly increased by irradiation was taken advantage of.

The report is quite extensive and detailed. From it they conclude that lymphomatosis as they studied it is a neoplastic process. The condition is transmitted only by material containing viable lymphocytes and when injected these cells grow and produce lymphocytes like those inoculated. Lymphosarcoma, leucemic lymphomatosis, aleucemic lymphomatosis and leucosarcoma are malignant processes and are different manifestations of the same disease. Two factors are chiefly concerned in determining the type of disease: (1) the possibility of the free entrance of the malignant lymphocytes into the circulation and (2) the character of the malignant lymphocyte.

Leucemic lymphocytes are not lymphoblasts but malignant (pathological) lymphocytes with limited power of maturation and when these cells multiply their characteristics persist. The success of the inoculations depends upon the character of the malignant lymphocyte persisting through several passages, as well as upon external factors such as the dose, the route of entry and the resistance of the mice.

A single roentgen exposure is sufficient to destroy the resistance of insusceptible mice to the implantation of leucemic cells. The smallest amount of irradiation to bring about this change is approximately 30 r and the percentage of successful inoculations increases with the quantity of irradiation.

Irradiation of mice immediately after inoculation does not destroy all the malignant cells and does not prevent a fatal termination, but does prolong the duration of the disease by about 20–50 per cent, probably by a partial destruction of the cells.—*J. H. Harris.*